TOPICS OF THE MONTH

Radioactive wastes—a problem for the world

THE industrial revolution that brought prosperity and a higher standard of living to civilised peoples also brought some less desirable effects, such as air and river pollution, and the concentration of populations into large, unhealthy cities. Early steam-powered factories were sited without much consideration for any harmful effects they might have on the population and the surrounding countryside, and some of the evils that scientists and sociologists are now trying to remedy might have been mitigated if more thought had been given to these matters in the first place.

Even while fighting these evils we are entering a new phase of industrial development brought about by atomic energy, which is seen by many as the 'new industrial revolution.' Along with the promise of a glowing future held out by atomic energy comes a new waste menace, this time involving radioactivity. If smoke and grit in the lungs are unhealthy, radioactivity inside one in any undue quantity is certainly unhealthier. Let us hope that the lesson of the first industrial revolution has been learnt and that, where atomic energy is concerned, industrial development will not outstrip knowledge of how to deal with the waste problem and planning in accordance with this.

Present opinion seems to indicate that the seas and oceans will be the eventual receptacles of radioactive waste, and for some comments on this subject we turn to Dr. D. B. Finn, director of the fisheries division of the Food and Agriculture Organisation. Dr. Finn stresses the necessity for the fullest international co-operation in acquiring knowledge and experience on how and where to dispose the radioactive wastes so that when the time comes we can be sure of the safe disposal of great quantities. He points out that the oceans of the world can absorb the wastes without any great hazard, providing the concentration of radioactivity is avoided and that the methods and means of disposal are scientifically controlled and efficient.

Dumping the wastes in the deepest part of the ocean does not necessarily, it seems from Dr. Finn's remarks, provide a solution, for little is known about the changes that take place at great ocean depths and, apart from any gradual change which may take place in the deep waters, there is also the possibility of underwater earthquakes and other disturbances. The mobility of fish and the ease with which they and the marine plants on which they feed take up radioactivity create further complications.

There is undoubtedly justification for Dr. Finn's contention that this question of the disposal of radioactive wastes is among the most important facing the oceanographers, biologists and other scientists of the world, and it is essential that they tackle it together.

Engineering training and incentives in Russia

WITH engineering teaching the highest-paid profession in the country, complete exemption from National Service for engineering students, two-shift working of a six-day week in many of the training establishments, and the fact that in Russia engineering is so highly rewarded and socially acceptable that there are 3.6 applicants for every vacancy on an engineering course, some of the mystery of how Russia is training three times as many engineers as Great Britain per head of population is explained.

These facts are given in a 25,000-word report 'Engineering Education in the Soviet Union' published by the Institutions of Civil, Mechanical and Electrical Engineers, which was prepared by a team of nine engineers, led by Prof. E. Giffen (Professor of Civil and Mechanical Engineering, London University), who visited Russia under the auspices of the British Council on a fact-finding mission in the autumn of 1956.

In the beginning of the report, some comments are included on the development of Soviet technological training from earlier times, and in Leningrad the mission visited the Chemical Technology Institute, which appears to be the oldest institute, having been established in 1828. This was understood to have served as a model for institutes later established in other parts of northern Europe, *e.g.* the technical high schools of Germany; and indeed the system of higher education is largely the same in those countries.

But the industrial scene in Russia is much different from that in other countries and, finding herself a long way behind in the provision of engineering works of all kinds, and consequently in the improvement of the standard of living of her people, she set herself a herculean task to build up in the minimum time a great industrial force and to produce the capital equipment needed to exploit her natural resources.

Russia finances research on an impressive scale. Academic staff may augment their already high salaries by 50% by engaging in this kind of work, while some Government departments in Britain in their research contracts with universities refuse to allow the academic staff concerned to receive payment for their services. In relation to the supply and demand of engineers the Russians also have the advantage over Britain since the Government is able to assess the coming needs for engineers and regulate the supply accordingly, although in this respect it should be noticed that incentives have largely taken the place of directives.

Looking at the curriculum, the syllabuses and other elements of the course of study leading to the award of an engineering diploma in Russia, it appears that the main differences from the British method are the

younger age at entry, the longer course, the greater specialisation in the fourth and fifth years, and the diploma project as the culminating point and the most important factor in determining success or failure. While the student in Russia does not proceed as far in as wide a range of fundamental engineering subjects, he has gone much further in the technology of a particular special subject and might have carried out a design project under a practising engineer and, at the end of his longer course, is ready to take his place in industry as a member of a design office, in a team of development engineers, or in a junior executive post.

In Russia the practical training occupies 200 to 300 hours in the workshops of the institute and three periods of two months each in industrial works. The Russian student gains some elementary experience in the use of tools and machines in the institute's workshops; in industry he works, not on the shop floor but as assistant to another engineer, sometimes in a junior managerial position.

While mainly concerned with the undergraduate work of the engineering institutes, the mission have some brief comments to make on research work in Russia, of which they formed a high opinion. Not so eulogistic are their views on the practical training given in mechanical and electrical engineering, the equipment seen being old-fashioned and the work of low standard.

But the report gives a clear indication that a great deal of effort and enthusiasm, coupled with generous incentives, is going into the Russian drive for more engineers. One conclusion reached in the report is that the Soviet Union is still far behind Western Europe and America in the amount of power available per head of the population, and will not relax until this leeway is made up. Nevertheless, it is pointed out, even if the rate of training engineers in Britain was greater than in Russia—and the comparative figure is 65,000 yearly in Russia against 5,000 in Britain—Britain could not afford to be complacent, for the development of new ideas and new techniques in a given time is not related to the size of the population.

Chemical stops water evaporation

LATEST country to turn to the use of hexadecanol (cetyl alcohol) for preventing evaporation of water in open reservoirs is Northern Nigeria, where it is believed that loss of water by evaporation is about 6 ft. p.a. Experiments are being carried out with specially designed rafts which will operate in the first instance at the Bosso Dam.

It was in October 1955 (page 349) that we reported a method of applying cetyl alcohol, using a new, pelleted form, was being tried out on reservoirs in Kenya, the pellets being enclosed in fine copper-mesh baskets in the framework of box-like rafts. Previous use had been made of cetyl alcohol to combat the water problem in Australia, but not with pellets, which were claimed to be more effective than the flake form.

Neoprene containers for polythene

A NOVEL means of transporting granular polythene resin has been devised in the United States where a manufacturer, faced with the high cost of shipping upwards of 250,000 lb./month of polythene over some 500 miles in paper bags, was led to consider the possibilities of large neoprene containers. These each have a capacity of 300 cu.ft., equal to about 190 of the paper bags they replaced. They are transported by rail in long, open wagons each holding seven of the containers and are loaded and unloaded with fork lift trucks.

Empty containers are inflated, washed and air dried, and a monorail moves clean containers to the loading hoppers. For unloading at the other end of their journey they are transferred to a supporting cradle and discharged through a bottom opening, the empty containers being collapsed and returned to the shipping plant.

Details of these containers have been given in a recent bulletin from the elastomers division of E. I. du Pont de Nemours & Co. (Inc.), according to which the bulk containers have not only brought considerable saving in labour but have also reduced contamination and physical losses. Also, since they can be deflated and stored out of doors when empty, they do not require expensive warehousing space. Obviously this is an idea that might catch on where some other materials are concerned.

And now—fibre metallurgy

A NEW method of using metals, developed by the Armour Research Foundation in the United States, resembles that used in powder metallurgy, except that the metal is used in the form of short fibres instead of powder. The resulting products are stated to possess great strength and toughness and, if required, a controlled degree of porosity.

It is stated that the fibre aggregate can be filled with a plastic for an application such as the surface of an aircraft wing, or with a ceramic for gas-turbine blades, where it is said to reveal a marked gain in impact strength. The unfilled material can be used as a filter.

According to American reports, the rights for the production of these materials have been acquired by an industrial group, so that little has as yet been published on the methods of manufacture. One method which has been suggested, however, is a felting operation similar to the Fourdrinier process for paper making. The fibres are suspended in a liquid and felted by pouring the suspension over a filter to which suction is applied. The dried material can be processed in various ways, such as sintering, impregnating or pressing to a higher density.

These facts were given in a brief report in our associate journal *Textiles in Industry*, according to which it is expected that the new materials will offer useful possibilities in the aircraft and chemical industries, either in cartridge form or in the form of continuous filter cloth.

Italian mercury cells for U.S.

A PROCESS for the electrolysis of hydrochloric acid in order to recover the chlorine from the waste hydrogen chloride produced in some chemical processes, thus exploiting a hitherto unused by-product and overcoming the increasingly urgent problem of disposal, has been devised by the Italian firm, Oronzio de Nora. Fifty-two mercury cells of a new design will be installed at the chemical plant of Diamond Alkali Co. at Deer Park, near Houston, Texas, as part of its multi-million-dollar expansion programme. Electrolytic production of chlorine is to be increased by some 30%, or 200 tons/day. With a rated capacity of 120,000 amp. these mercury cells will be the largest of their kind in the world.

The recovery of chlorine from hydrogen chloride can be carried out in two ways: either by the oxidation of the hydrogen chloride by means of oxygen in the presence of a catalyst or by the electrolysis of muriatic acid. Of these two methods, the latter is claimed to have the advantage, owing to the simplicity of the equipment and to the relatively low cost of installation and operation. Moreover, the electrolysis process is characterised by remarkable flexibility. Whenever necessary the electrolytic cells can be overloaded by as much as 50% above the rated capacity. For this process a cell has been specially constructed from materials highly resistant to the chemical attack of hydrochloric acid and chlorine.

The most significant feature of this cell is a new type of high-conductivity diaphragm. Although permanently in contact with hydrochloric acid and chlorine at high temperatures, a long life for the diaphragm, as for the cell itself, is assured.

American processes in Europe

THE growth of the chemically related industries in Western Europe during the last four years has outstripped the proportional growth of their counterparts in the United States and is indicative of their tremendous progress. Contrary to a common misconception, even French chemical companies have grown more than their American equivalents during this period. The average European chemical growth from 1953 until the Middle East crisis was 12% p.a., compared to somewhat less than 10% for the United States, including tremendous growth in 1955 which compensated for the rather poor U.S. showing in 1953 and 1954.

This comparison was made at a joint meeting of the American section, Société des Ingenieurs Civils de France, and the American section, Société de Chimie Industrielle, of Paris, held in New York recently, by Dr. R. S. Aries, head of a New York consulting firm of that name. He had recently returned from a two-months survey trip and reported that the average net profits after taxes of the publicly owned chemical process European companies is about 6% of their sales, compared with about 9% for U.S. counterparts. He stressed that petrochemical growth is the most impressive and that American processes have been very prominent in the post-war industry development. Hundreds of agreements are in existence involving joint ventures, engineering and licensing with U.S. firms.

Western-Europe-manufactured products based on U.S. licences are conservatively estimated to sell for $1 billion annually and provide about $30 million of annual income to U.S. companies. Processes have also been purchased from Western Europe by North American companies at an increasing rate since 1951, most of which have been based on inventions rather than complete 'know-how.' It is expected that in a decade the technical flow will be about equal in both directions.

It was also pointed out that the term 'technical currency,' coined by Peter Grace, president of W. R. Grace & Co., has been adopted by many to explain the policy of international exchange of processes. In view of heavy taxation throughout the world and the tremendous demand for good processes, money alone (even dollars) is not enough for international process acquisition but is supplemented by other processes or improvements in barter-type operations.

Heavy chemical projects in India

THE new soda ash expansion project of Tata Chemical Co. in India, briefly refered to in this issue, is only one indication of the changes that are taking place in India's heavy chemical industry, for the production of soda ash, caustic soda and liquid chlorine—basic chemicals required for the development of chemical industries in the country—is to be increased nearly fourfold during the second five-year plan. According to an official press release, it has been possible to fix this high target because of the record increase in the production of these chemicals achieved in the last few years.

The production of soda ash by 1961 is expected to go up to some 250,000 or 300,000 tons from 77,270 tons in 1955. The output of caustic soda will increase to 200,000 tons from 34,250 tons in 1955 and liquid chlorine to 250,000 tons from 14,580 tons in 1955.

The production of these basic chemicals increased five or six times during the period 1946 to 1955: soda ash from 12,000 tons to 77,270 tons; caustic soda from 2,900 tons to 34,250 tons; liquid chlorine from 2,900 tons to 14,580 tons.

Bright ideas pay off

CHANGES in plant and processes usually originate in the research laboratory, but there are often improvements which can be carried out by those who actually work the plant and who may be more aware of small details of operational efficiency. This, at least, is the belief of the Esso Petroleum Co. Ltd. and the success of their 'Coin Your Ideas Plan,' by which any suggestion which contributes to the greater

efficiency of the company is rewarded in direct relation to the economies effected, seems to justify their faith.

Recently, an assistant stillman, Mr. G. Belenger, was presented with an award of £774 11s. His idea has enabled the company to make a considerable saving by eliminating loss of catalyst which had previously escaped to the atmosphere during transfer from the main storage tank to the catalytic cracking plant. This is his eighth award since he joined the company five years ago, and at the same time awards were made to three other refinery employees who together put forward a plan which not only reduced the problems associated with the disposal of waste oil but enabled quantities of oil to be recovered and processed. In all, since the introduction of the scheme, 1,448 ideas have been adopted and the total awards amount to £8,445.

These, the latest presentations, are the highest so far made under the plan, but other proposals recently considered included the blanketing of insulated pipes, a revision of telephone numbers, extra parking facilities, safety caps for rubber boots, advertising, a portable calibration set, a modification to a grease mixer, accident prevention and stationery, as well as numerous ways of streamlining or effecting economies in refining processes.

Telephone tie-up for I.C.I. Plastics Division

THE fast-expanding Plastics Division of Imperial Chemical Industries Ltd. at Welwyn Garden City reached an important stage in its history recently with the opening of a new £500,000 technical service and development building. This houses several laboratories equipped for extensive research work into plastics end-products, as well as machinery using the latest techniques in processing plastics raw materials. Technical education facilities, and all the subsidiary organisation required to give a complete service to customers, are also provided.

As the organisation has expanded, an ever-present problem has been to ensure that internal communications kept abreast of requirements. The manual switchboard positions quickly proved inadequate to cope efficiently with the daily volume of internal telephone calls and the incoming and outgoing traffic, and the problem has now been solved by the installation of one of the latest types of Strowger private automatic branch exchanges.

The new telephone system, which has been installed by Automatic Telephone & Electric Co. in collaboration with the Post Office, has an initial capacity for 1,000 telephone extensions, with 60 public exchange lines and 10 manual switchboard positions. Offices and laboratories throughout the organisation have been linked to form one comprehensive network. Before the inauguration of the new system all internal calls were handled by switchboard operators, who have now been freed to concentrate on public exchange calls. Eleven private wires are also used to link the division with other sections of the I.C.I. organisation throughout the country.

Winter gets warm welcome on Canadian construction site

THE construction of big chemical and petroleum plants often involves one or more of a variety of problems, including those of getting the materials there on time, labour shortages, transport and other difficulties due to geographical location etc., but the problem of hold-ups due to cold weather occurs in comparatively few areas of the world. Such a problem, however, is experienced in Alberta, whose cruel winter could easily freeze out any construction schedule and, in fact, much Canadian construction shuts down in the coldest part of the year. So, at first sight, the M. W. Kellogg Co.'s choice of this period for the construction of a new 142,000-tons-p.a. chemical fertiliser plant at Medicine Hat, 35 miles from the Etzikom gas fields, is surprising. But the strategy behind it was that western Canada's supply of skilled construction labour is limited, especially during the present spate of big natural-gas and chemical projects, and only during winter does demand slacken. Other considerations were that Kellogg's procurement department would have materials on site for autumn and winter construction and the target date could be met easily if foundations and sufficient prefabrication work were completed during the winter.

So the job was planned thus: a fast, early start on foundations; special winterising techniques so that men could work during the coldest months; and winter fabrication to take advantage of the seasonal availability of skilled labour—particularly welders.

As construction progressed and the temperature dropped, construction crews began closing in foundation areas. Temporary structures of wood and tarpaulins were set over foundation sites. Heaters warmed the air within. Men could work and concrete be safely poured even in the coldest weather. This dedication to winter work proved a clear-cut advantage. Vital time in the construction schedule was not surrendered to winter cold.

The swift progress of construction was cryptically recorded in the field engineers' log: January 9, 1956—Began fabrication of vessels for sulphuric acid unit; January 18, 1956—Setting compressors in compressor house of ammonia unit; January 25—Erecting structural steel for reformer furnace of ammonia unit; February 2, 1956—Fabricating rolled plate for waste-heat boiler of sulphuric acid unit; March 8, 1956—70-ft. carbon dioxide absorber unit set in place.

Behind it all, obviously, was not only steady progress on the actual site, but also careful planning to ensure the arrival of the right materials at the right time during the construction period. So the plant was completed on schedule and winter retired defeated.

The plant is that of the recently formed company, Northwest Nitro-Chemicals Ltd., and includes six process units for converting natural gas, air, water, sulphur and phosphate rock to ammonium nitrate and ammonium phosphate fertilisers. Kellogg's steam methane high-pressure reforming process is being used to make synthetic ammonia at the rate of 100 tons/day.

Ebonite

AS A MATERIAL OF CONSTRUCTION FOR CHEMICAL PLANT

Less spectacular than some of the newer materials of construction that we hear so much about, ebonite is extremely versatile and holds its own in a great number of applications, especially where corrosive conditions are encountered. Some useful information about these applications is included in this article.

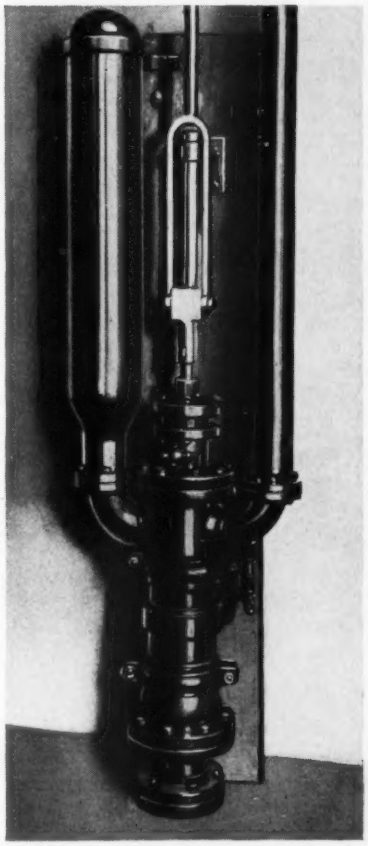
THE development of modern plastics has greatly increased the range of materials available for the handling of corrosive fluids. Plastics are light, attractive in appearance, reasonably efficient for the purpose, and highly fashionable. But there is a danger that the glamour which undoubtedly attaches to these gay newcomers may tend to obscure the strictly utilitarian merits of some of the older and less spectacular materials.

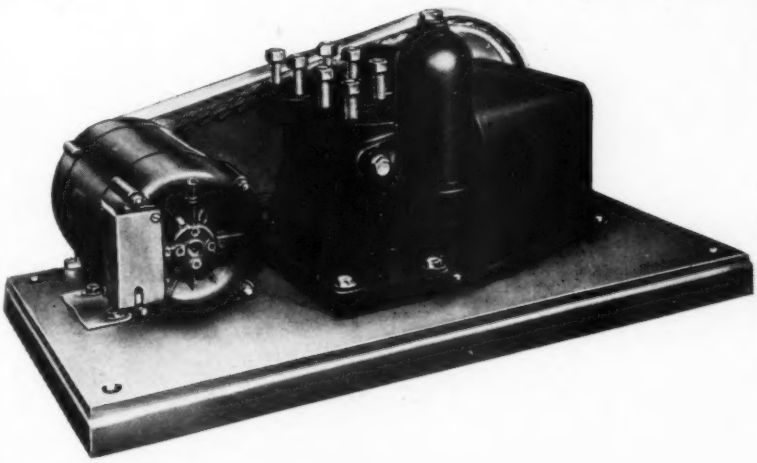
Ebonite, or hard rubber as the Americans call it, is stated to have been the first material developed to break the age-old dominance of lead, glass, wood and porcelain in the chemical plant field, and is still among the most versatile. Although there are few chemical, mechanical or electrical properties in which it cannot be at least equalled by one or other of the plastics, it is claimed to have the very great advantages of easier processing and the combination in a single material of a wide range of important properties. It can therefore be seen as a material with an unlimited range of uses, whether it is employed as a lining or covering for mouldings, extrusions, machined or hand-built articles.

Meeting special conditions of service

Ebonite is available in a wide range of grades for different conditions of service, including special conditions which may have to be met in chemical plants, and in selecting the appropriate grade for particular conditions a number of factors have to be taken into account, *e.g.* type of corrosive fluid, temperature, freedom from staining, mechanical strength, electrical strength, hardness etc. One great advantage is that the compounding formula is throughout under the control of the processor, who will in each case choose a compound to give optimum qualities for the particular application required. Moreover, any of the rubber manufacturers who specialise in ebonite will generally be prepared to design a compound for any unusual application.

One example of what can be done with special compounds is the production of higher-temperature-resisting ebonites. The softening point of ebonite used for general purposes is 65°C., which is adequate for a very wide range of applications. Above 65°C., standard ebonite should not be used, but where higher temperatures





Two examples of ebonite equipment are (*above*): vinegar pump installed in 1886 and still in operation at a recent date and (*left*): a centrifugal pump.

have to be provided for it is possible to formulate grades of ebonite which will withstand 100° or even 120°C.

Similarly, where standard ebonites, tested for impact strength by the *Izod* method, give figures in the region of $\frac{1}{3}$ ft.lb. (representing the energy absorbed in fracturing a test piece $\frac{1}{2}$ in. × $\frac{1}{2}$ in., notched to a depth of 0.1 in.), special high-impact grades can be produced which yield figures as high as $1\frac{1}{4}$ ft.lb.

Handling difficult chemicals

The range of chemicals to which ebonite is resistant is extremely wide. Normal ebonite is not recommended for use with hydrocarbons, oils or organic solvents, and is resistant to the oxidising acids only in diluted strength, but special grades incorporating synthetic rubbers can be used for these conditions. For pipelines, storage and transport vessels handling hydrochloric acid and sodium hypochlorite —two of the most widely used corrosive chemicals in industry—ebonite is still claimed to be the material *par excellence*.

Thus ebonite provides an admirable protective material for storage, transport and processing tanks, pipelines, valves and fittings when required for pickling and plating baths, for rayon plant or for handling such diverse corrosive fluids as vinegar, citrus fruit juices, dyes, pharmaceutical chemicals, explosives, bleaches, tanning and photographic chemicals.

Bonding with metal

Possibly the greatest advantage of ebonite is the method of its application. It is applied in the form of soft, flexible sheets and then vulcanised in place so that it forms a close chemical bond with the metal of the tank or pipe. A good ebonite-to-metal bond will resist a direct pull exceeding 2,000 p.s.i. This is particularly valuable under vacuum conditions where the strength of the ebonite-to-metal bond obviates any danger of the lining pulling off or collapsing within the tank. Similarly, steel tanks and pipes lined with ebonite will withstand any pressure for which the metal parts are designed, ebonite being one of the few materials which does not blister when these high pressures are released.

For transport vessels it is possible to bond a layer of soft rubber between the ebonite and the metal, thus cushioning the ebonite and greatly reducing the risk of cracking under shock or as a result of expansion and contraction due to extremes of temperature change. Again, buckets for carrying corrosive fluids are available with soft rubber sandwiched between two layers of ebonite, and will hold together even when one layer of the ebonite is broken by accident or careless handling.

Another lesser-known application is as a protective covering for iron pipes laid underground in highly corrosive soils.

Long-life pumps and fittings

Pipes, valves, cocks, unions, bends, tees, crosses and, in fact, the counterpart of most fittings made for steam and domestic plumbing have long been available in ebonite in a standard range of sizes. They are easy to install and maintain and, provided they are adequately supported, they have a remarkably long life. There are records of ebonite pumps and fittings which have given continuous and satisfactory service at a vinegar brewer's for as long as 65 years. In the large sizes of fittings and for pumps, the ebonite can be reinforced by means of a metal insert completely embedded in the material.

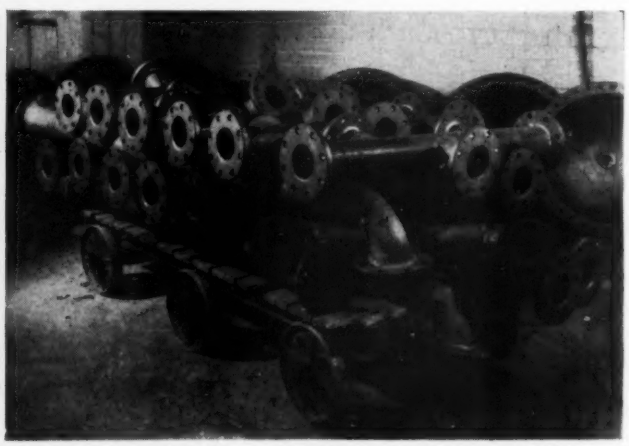
The resistance of ebonite to corrosion and the close bond to metals obtainable provide an excellent combination for pumps of the centrifugal type. All the internal parts of the casing and the impeller are completely covered with ebonite, and the inlet and outlet flanges are covered as well. A compact but powerful pump is thereby provided for the handling of corrosive liquids. It is readily available in sizes to operate with ebonite or ebonite-lined piping for rapid transfer of corrosive fluids without splashing or waste.

Other uses of ebonite

The bonding properties of ebonite and its ability to take a high polish make it especially suitable for covering centrifuge baskets, agitators of various kinds, and fans and ducting for use with corrosive vapours and gases. Its exceptionally low water absorption makes it invaluable as a material for certain components in water meters.

For small quantities of mouldings ebonite has a decided advantage, as the moulds can be constructed comparatively cheaply from cast iron or soft steel. Alternatively, when only one or two articles of a given pattern are required, moulds can be dispensed with altogether, as the parts can be hand built and machined to fine limits.

Finally there is the proved ability of ebonite to give long and reliable service. It does not deteriorate with age or lose its mechanical or physical properties and, barring mechanical damage, the life of properly designed ebonite installations is practically unlimited.



Left: **Rolling out bubbles in the ebonite lining of ducting for pulverised coal.** *Right:* **Ebonite-lined acid-resisting pipes.**

EXPLOSION RISKS IN INDUSTRY

By A. R. Myhill, F.R.I.C., M.Inst.Gas E., M.Inst.F.

Notwithstanding the comparative rarity of serious explosions in the manufacture, storage, and transport of common materials of commerce, the hazard to life and property is a widespread potentiality. This article outlines some of the causes of accidental explosions and discusses means which may be taken to avoid or minimise the risks.

EXPLOSIONS may be brought about deliberately, under control, to serve some useful purpose, as in the case of blasting, munitions, or internal combustion engines. The present article considers conditions under which accidental explosions, capable of leading to loss of life and destruction of property, are caused. Most explosions of this type are produced as a result of extremely rapid combustion, accompanied by the sudden evolution of great heat, and a disruptive increase in pressure within a confined space. Other kinds of explosion, not so common in industry or commerce, are those produced by chemical reactions other than combustion, such as involve rapid molecular changes in the substances present, as in the case of the so-called 'high explosives,' or in laboratories where decomposition of unstable substances takes place. A further type is the bursting of a vessel, such as a steam boiler or air container under conditions of sudden mechanical failure due to high pressure. This is physical, rather than chemical, in nature, and its avoidance is simply a matter of constructional engineering, and is not considered in the present article.

Combustibles and explosions

In the case of the combustion types of explosion, the tendency to explode and the violence of the effect will depend on the rapidity with which combustion can be made to take place, and this, in turn, depends on several fundamental factors. In the majority of cases, air is the oxidant, and the 'combustible' may be solid, liquid or gaseous. To produce a violent explosion, intimacy of mixing and homogeneity of composition are essential. For this reason, it is necessary that a solid component should be in the form of an extremely fine powder, and that a liquid should be finely atomised, so that the particles present the maximum surface to the oxidant, and are capable of effective suspension in it. On this account, conditions most favourable to explosion are brought about most readily when the combustible is a true gas, since the ready miscibility of such gases with air produces a homogeneous atmosphere.

Fig. 1. Simplex flameproof handlamp.

Whether the combustible be a solid, liquid or gas, its mixture with air will only be explosive when the proportions of combustible and air lie between certain well-defined limits, known as the upper and lower limits of inflammability. Such limits vary considerably with different components. In general it may be taken that a mixture of air and any combustible having a wide difference between upper and lower inflammability limits will be more liable to explode than a mixture which has only a narrow difference in limits. As examples, the hydrogen-air limits are 4% for the lower limit and 74% for the upper limit, expressed as percentages of H_2 by volume. Butane, on the other hand, one of the principle constituents of calor gas and similar petroleum products, has much closer explosive limits, the lower being about 1.9% and the upper 8.5%.

Hydrogen/air mixtures are therefore much more liable to be explosive than butane/air mixtures. Moreover, the extremely high flame velocity of the former presents a greatly added risk, since this means rapid propagation of a flame from the seat of origin to more remote localities, and may cause secondary explosions. A flame of this nature is always less responsive to attempts made for its extinction, such as flame traps or inert diluents. For these reasons, gas mixtures containing high proportions of hydrogen often need much more stringent precautions against explosion than other mixtures. Where the combustibles other than hydrogen in the mixture have also large differences in explosive limits or have high flame velocities, the risk is greater than when they have small differences or lower flame velocities. Thus mixtures of blue water gas and air are more liable to explode than mixtures of coal gas and air, even though the percentages of hydrogen in the combustibles present may be the same in each case.

The only combustible in blue water gas other than hydrogen is carbon monoxide, which has wide inflammability limits, while the combustibles in coal gas consist largely of methane and other hydrocarbons having comparatively narrow limits.

The following table shows typical inflammability limits of various gases and vapours in air:

	Lower limit %	*Upper limit* %
Benzene	1.4	7
Blast-furnace gas...	35	74
Butane	1.9	8.5
Carbon monoxide	13	74
Petrol	1.4	6
Methane	5	15
Coal gas	5	30
Blue water gas ...	7	60
Propane	2.4	10
Hydrogen... ...	4	74

Secondary effects

Explosion dangers may include not only damage, injury and loss of life brought about by the original explosion, but also secondary effects such as fires and explosions in remote localities due to the travel of the explosion flame along ducts. Toxic hazards are also present after an explosion, particularly with coal dust or gas explosions. In such cases the products of combustion generally contain lethal proportions of carbon monoxide and often leave the atmosphere so far denuded of oxygen as to render it unbreathable.

In cases of accidental firing of high explosives or special chemicals, the atmosphere may become laden with toxic organic substances.

Strange effects of explosions

The travel of an explosion flame along a duct presents interesting physical and mechanical problems. Although such a flame may travel at rates of a few yards per second, experience of explosions which take place in long pipes has proved that acceleration to detonation velocities of thousands of yards per second can be produced.[1] This is considered to be due to shock waves originating in the flame front which, after reflection, overtake the travelling flame and accelerate it. Under favourable conditions, acceleration to the stage of coalescence of shock and flame fronts would occur, and a detonation wave would be formed.

During the last war, attention was called to many cases in which it was found that particular groups of warehouses and factories suffered far more damage in air raids than would have been expected in view of the size and power of the high-explosive weapons used. The buildings showing this peculiarity were those in which large quantities of combustible material were stored in powder form. Such materials included coal, coke, and wood dust, food products such as flour, cocoa, sugar, starch, etc., and finely divided metals such as zinc, aluminium and magnesium. Although in most cases these substances did not occur primarily as suspensions in air in manufacturing processes, the powders became scattered by the primary explosion from their original heaps, bags or casks, and became disseminated through the whole atmosphere of the building, forming highly explosive air-powder mixtures which, becoming ignited, very greatly extended the damage.

Not only was the explosion danger greatly increased, but the passage of flame over considerable distances was responsible for great damage from fire.

Liquids and explosions

The explosion and fire hazard potentialities of low-boiling volatile organic liquids such as petrol and alcohol are widely recognised, since it is well known that their vapours readily form explosive mixtures with air at ordinary temperatures. Other liquids, by reason of their low volatility, are not normally regarded as dangerous. Nevertheless, dispersions of such liquids by atomisation or by condensation can form highly explosive mixtures. Lubricating oils and heavy fuel oils, for instance, have sometimes been responsible for disastrous explosions of this nature, a classic example being the case of the M.V. *Reina del Pacifico* during her sea trials in 1946, which suffered a crank-case explosion resulting in the loss of 28 lives.[2] The overheating of a piston in a 12-cylinder engine caused an explosion which spread to the crank cases of other engines and finally to the engine room itself.

Other similar cases have occurred of like nature, although these are now very rare, on account of the precautions taken. The explosive medium in these occurrences is a mist or suspension of finely divided oil droplets in the air of the crank case, resulting from volatilisation of lubricating oil in contact with an overheated engine part.

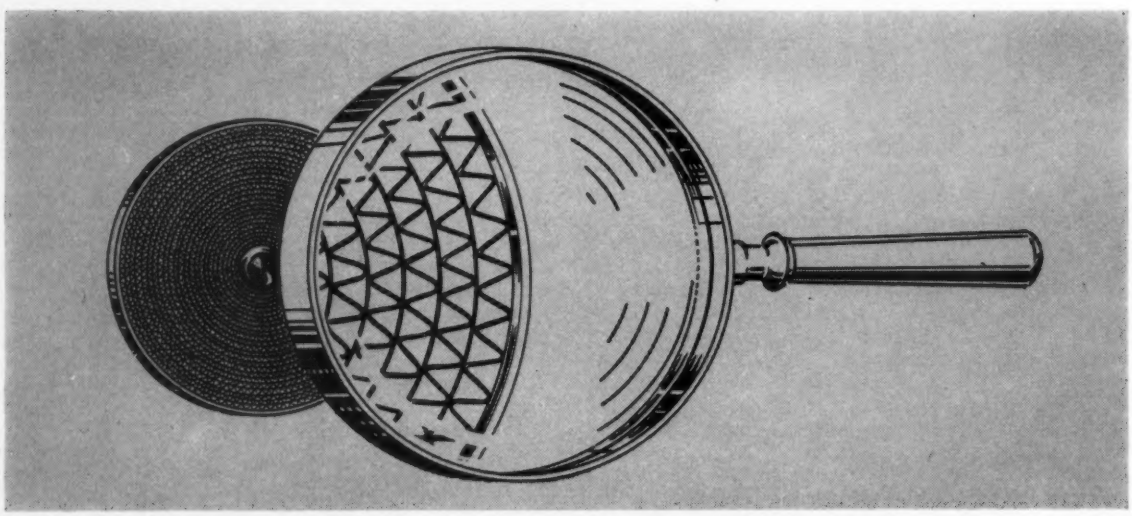


Fig. 2. *Left:* **Amal flame trap.** *Below:* **Enlarged view of the flame trap showing arrangement of the cells.**

Precautionary measures

Some of the methods employed to guard against the possibilities of explosion relate to particular circumstances or special industries. Many are, however, merely applications of commonsense. It is unfortunately true that the comparative rarity of serious explosions often restricts one's awareness of dangerous situations and leads to the taking of risks. It must be admitted that freedom from accident often comes about more by luck than from sound judgment. In this connection, it cannot be too strongly urged that breach of safety regulations in factories and warehouses should be the subject of the strongest disciplinary action.

Where an explosive atmosphere is known to exist or is likely to be present, the first safety factor to consider is the prevention of ignition.

Prevention of ignition

Ignition can be effected not only by the agency of an open flame but also by sparks and hot surfaces. With certain chemicals, as, for example, carbon bisulphide, ignition is possible by contact with objects at ' black heat,' such as pipes carrying superheated steam or outside walls of furnaces. Ignition from sparks, caused by tools used for chipping, grinding and hammering, can be avoided by the use of special appliances made from bronze and other alloys.

Tools of this type, both for manual operation and in mechanical equipment, are used for digging out hard materials from oxide purifiers at gas works. Lids of tanks, including road and rail tankers, which contain inflammable liquids should not be forced open with iron or steel appliances, but special hard rubber or polythene tools should be used.

Electrical equipment is always a potential source of danger, and flameproof types of switches, fuse boxes, lamp-holders, etc. must be used. Fig. 1 illustrates a flameproof handlamp made by Simplex Electric Co. Ltd.

Where it is necessary to use portable electric appliances, these must be of special design. The use of open electric radiators is obviously out of the question. Electric motors and tools having moving contacts must be totally enclosed, and all metal framework must be earthed, especially in cases where static charges might accumulate. Lighting equipment should have thick glass protecting covers.

When conveying inflammable liquids through flexible hose, as when filling and emptying tanks, electric charges may be generated by the friction of the liquid passing along the wall of the pipe. Such charges must be instantaneously dissipated by earthing the tank as well as the armouring on the hose, special precautions being taken to ensure effective electrical bonding at joints in the pipeline and at connections to pumps, etc.

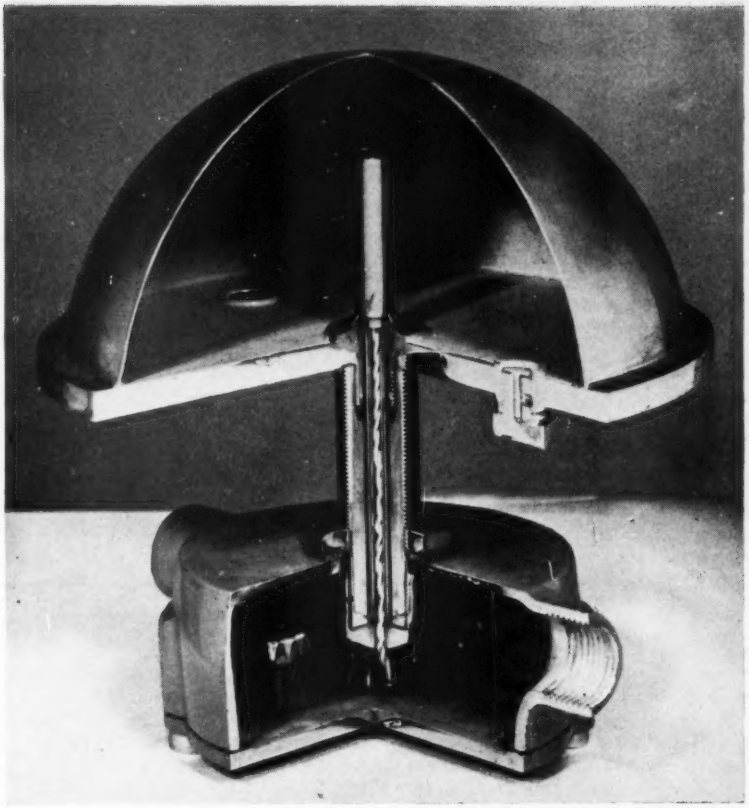


Fig. 3. Hemispherical explosion suppressor made by Graviner Manufacturing Co. Ltd.

Electrostatic dust or mist precipitators must never be used in vessels liable to contain an explosive atmosphere. When properly working, such apparatus should not produce any sparks, but should only give a ' brush ' discharge which, normally, would not ignite the mixture. In general practice, however, it is quite common to have sparking or arcing from time to time on account of minor faults.

A particular case of the use of an electro-precipitator is in the de-tarring or removal of ' tar fog ' from crude coal gas and other fuel gases. This is the only process in normal gas works' practice where a potential source of ignition is permitted within a gas-filled vessel and, in ordinary circumstances, is quite safe since, even if sparking occurs, no danger would result, since the atmosphere, being substantially air-free, is non-explosive. Exceptional conditions could prevail, however, whereby an explosive mixture could be produced in the de-tarrer, as, for instance, where air might be drawn through a leak, into the gas stream at the inlet to the apparatus, by suction from the exhauster. Although this possibility exists, the probability of an explosion due to this cause is considered very remote, in view of other factors. The writer has never heard of a case where this has happened.

Precautionary measures, nevertheless, are generally taken to avoid such a risk. One suggested method, which has been patented, involves the use of a device which is capable of detecting oxygen in the gas stream prior to the de-tarrer, and the automatic release of an inert gas from a cylinder into the apparatus to dilute the gas mixture to a concentration below explosive limits.

Such an apparatus needs to be very rapid in action and must respond well in advance of the gas flow.

Flame traps

Flame traps are used to prevent the ignition of an explosive mixture from an outside source. It sometimes happens that air or gas has to be displaced from a large vessel or a long main, either when starting up or shutting down an installation. Thus, when a new gas main is being put into commission for the first time, the air originally contained in the pipe is displaced by gas under moderate pressure, and vented to atmosphere through vertical stand-pipes. Under these conditions the atmosphere within the main is almost certain, at some stages, to be of an explosive character. It is, however, discharged at a considerable height, and at a place where there are no sources of ignition. As an additional precaution, however, it is customary to fit a flame trap at the exit of the stand pipe.

This device acts on the principle of the Davy safety lamp, as used in coal mines. Should the emergent mixture become accidentally ignited, the flame burning on the face or top of the trap is divided into a large number of tiny sections or flames, each burning in a restricted space and coming into intimate contact with the walls of small cells built into the apparatus. The heat is thus dissipated through the metal of the trap element, and the temperature at the face of the latter, remote from the source of flame, is brought below the ignition point of the gaseous mixture, so that no passage of flame to the main can take place.

Incidentally, it may be mentioned that flames from locomotives and chimney stacks have been known to ignite the gas escaping from stand pipes. This possibility must not be disregarded when planning the position of the pipe exits.

The Amal flame trap[3] shown in Fig. 2 is a well-known type, and consists of a unit made up of a mass of long, triangular cells of cupro-nickel strip, arranged as a flat cylinder secured in a brass body having a female thread in a hexagonal casting which can be fitted to any standard gas pipe. The trap has many applications in various industries, and can be supplied in a form suitable for incorporating in a pipeline connecting two vessels, each containing an explosive mixture.

Such a combination often occurs in chemical plant and, in the event of an explosion in one of the vessels, the passage of flame to the other vessel is avoided.

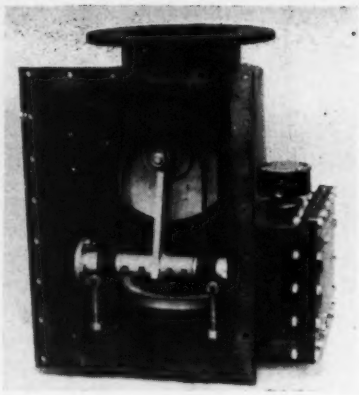


Fig. 4. Graviner high-speed isolation valve.

Use of inert dusts

In 1887, investigations made in connection with an explosion in a coal mine at Altofts, Yorkshire, revealed the fact that the explosion flame had not penetrated into certain passages in the mine which were known to contain large quantities of dust from shale and rock. It was suggested by Sir William Garforth that the coal dust raised by the original explosion of firedamp also produced an explosive mixture, but part of it was carried by the wind of the explosion into the dusty locations and the stone dust so raised served to dilute the mixture to proportions below explosive limits in these parts of the mine. The practical significance of this was not fully realised until about 1906, when investigations were carried out in Britain, on the Continent and in America on 'stone dusting' for the reduction of mine explosions. As a result of this work it has now become common practice to use finely ground stone dust of selected composition for this purpose. Such dust should be of approximately the same size-grading as that of the coal dust normally raised in the mine, and of a specific gravity favourable to suspension in air or mine gases.

The dust is spread on the floors of mine passages, particularly where gas is known to be present. In mines where gas is absent, stone dust is often not used, but the coal dust is kept down by the use of atomised water sprays during cutting operations.

In deciding the composition of the stone dust to be used, consideration must be given to its possible effects on the health of the workers. Many rock dusts contain large proportions of silica, which cannot be used on account of silicosis dangers. This disease is cumulative, since silicon particles are very difficult, if not impossible, to remove from the lung interstices. Limestone and gypsum deposits, however, generally contain very little silica, and dust made from these materials is usually safe to use.

Care must be exercised in the use of locally occurring stones, since these may contain mineral poisons such as lead, copper or arsenic.

It may be necessary to introduce quite large quantities of inert dust into a chamber full of a gaseous mixture or a mixture of air and coal dust before ignition is rendered impossible, but it has been found that very much smaller amounts in suspension in an explosion flame will serve to damp it out before it can travel far.

Preventing explosions of powdered foodstuffs

Interesting experiments carried out by the fire research division of the research and experimental department of the Ministry of Home Security led to successful applications of the use of inert dusts for the prevention of fires and explosions in connection with the storage of foodstuffs in powder form. Where such products are stored in quantity or processed in such a manner that dust from them may remain suspended in the atmosphere, it is now common practice to place packets of inert dust in such positions that any primary explosion which might take place will scatter it so as to damp out the flame.

The composition, state of grinding and other characteristics of such dust and the methods of placing it relative to the positions of the stored material are matters which have received considerable attention, and this has resulted in greatly increased efficiency in use.

As an example, the hygroscopicity of the powder is an important matter. This is important, since it is found that the addition of certain water-soluble constituents will increase the effectiveness of stone dust in preventing the passage of flame. Sodium carbonate in proportions up to 10% of the total has been used in this connection, but special precautions must be taken in storage, since a damp atmosphere may render it completely useless on account of caking. It has been stated that sodium bicarbonate is not so prone to this disadvantage and is equally effective in use.

(*Concluded on page* 144)

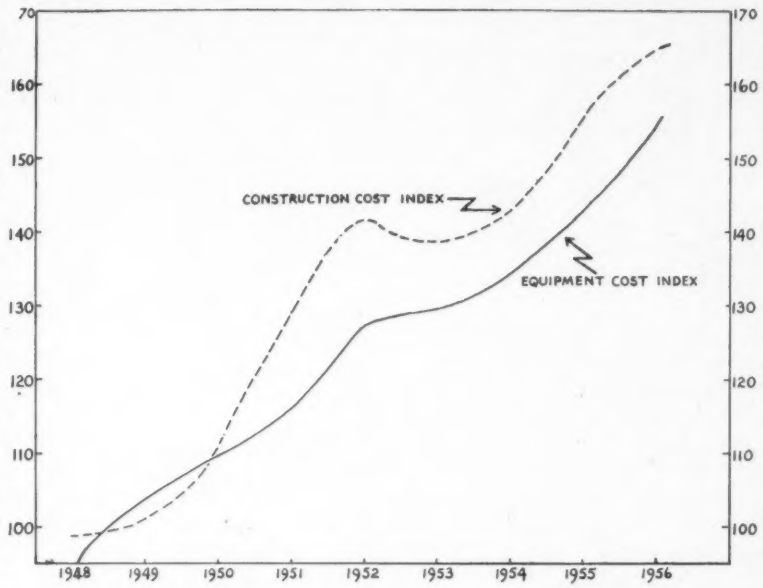
Cost Index for Chemical Process Equipment

ANOTHER C.P.E. SERVICE JOINS OUR CONSTRUCTION COST INDEX

AS an addition to the C.P.E. Chemical Plant Construction Cost Index, we now introduce our index for the cost of chemical process equipment, which is set out in the accompanying table. Additional figures will be published each month.

Because of the different distribution of costs in the shop and on the construction site, we would expect the equipment cost ihdex to rise less rapidly than the construction cost index. Labour is more productive in a well-tooled shop than on the construction site. In our February issue we plotted curves pertaining to American conditions which bear out the above assertion. The curves for British conditions which we present here also bear them out.

The C.P.E. Cost Index for Equipment is based on the cost of steel and non-ferrous metals in the proportions in which they are used in the chemical industry as a whole, and on the proportioning of materials, labour and overhead costs, selling expenses and profits, to be expected in an equipment fabricating shop.



Graph comparing the curves of construction costs and equipment costs.

C.P.E. Chemical Plant Equipment Cost Index

(June 1949 = 100)

	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Jan.							132.3	138.3	148.6	157.3
Feb.							132.3	139.1	149.4	
March							132.6	141.4	151.8	
April							133.9	141.5	152.5	
May							134.8	142.3	154.0	
June							135.4	142.4	155.4	
July							135.1	143.2	154.1	
Aug.							135.1	145.3	154.1	
Sept.							135.4	146.2	154.6	
Oct.							136.0	145.7	154.3	
Nov.							135.9	146.9	154.3	
Dec.							141.5	147.3	155.5	
Average	95.2	99.7	109.5	116.4	127.9	130.0	135.0	143.3	153.2	

C.P.E. PLANT CONSTRUCTION COST INDEX—LATEST FIGURE

Our table last month gave the C.P.E. index for the whole of 1956. The figure for January 1957 is **170.5** (June 1949 = 100).

Petrochemicals in Japan

The Maruzen Oil Co. has announced the opening of the first full scale petrochemical manufacturing plant in Japan at Shimotsu, Wakayama prefecture, Western Japan. The petrochemical plant, attached to the oil refinery there, will turn out secondary butanol from butane and butyl gas as a by-product from oil refining.

The secondary butanol will be used as a paint solvent and will be lower in price than the present solvent produced from molasses, the company states.

About 10 Japanese companies have been authorised by the Japanese Ministry of Trade and Industry to start petrochemical production on a commercial basis. The Nippon Petro-Chemical Co. is expected to open its factory in Kawasaki, near Tokyo, in May to produce acetone and iso-propyl-alcohol, while the Mitsubishi Oil Co. plans to start the production of benzol, toluol and xylol in November. In addition, the Sumitomo Chemical Industry Co. will turn out polythene in November.

The Nippon Petro-Chemical Co. stated that its production plan called for 2,000 tons p.a. of isopropyl alcohol and 3,500 tons p.a. of acetone every year.

How to Read Engineering Drawings

2. *Flowsheets*

By D. V. Pridham,
A.M.I.Mech.E.

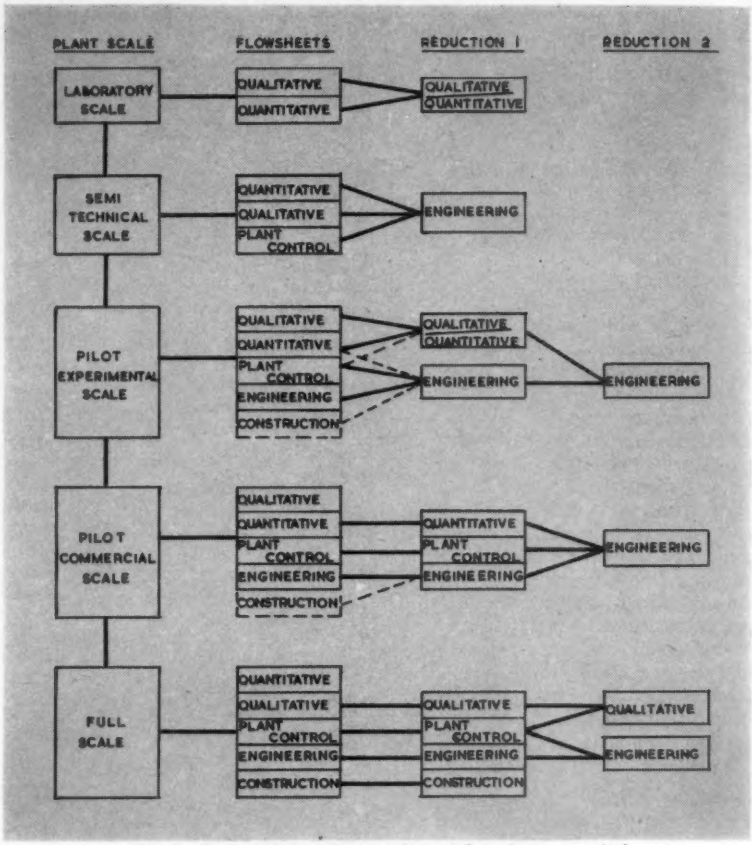


Fig. 1. Determining the number of flowsheets needed.

THE first article of this series (March issue) was devoted to the fundamentals of engineering drawing. Simple projection was discussed and there was a brief review of some of the techniques adopted to save draughting time or to add emphasis to selected design features. In addition to this the importance of coupling economy of effort to clarity of purpose was strongly underlined. No drawings of any kind should contain superfluous information and yet one must ensure they contain all the relevant information without leaving the reader to deduce the designer's wishes. A drawing is a command and for its correct execution it must be explicit. These remarks apply with the same degree of importance to the preparation of a flowsheet.

The purpose of the flowsheet is to provide an easily recognisable route through the complexities of a plant specification. In turn it assists in the preparation of the specification and then in the reading of it. It provides a picture of the material and energy changes which occur in the process, the method of controlling them, the method of containing them and the sequence of plant operations. The flowsheet provides the basis for technical discussion for developing design, running the plant and recording the results. No other drawing is capable of concentrating so much information and of presenting it so simply. It is therefore the most important, the most widely used, the most versatile and the most controversial drawing in use in the chemical industry today.

The flowsheet has a prime requirement: clarity. It is important to restrict a flowsheet to giving sufficient information for each purpose, without duplication and without obscurity. For this reason it is often necessary to produce a number of flowsheets each containing a selection of plant data. This data should be carefully chosen, so that the topics chosen are of an associated interest on each flowsheet. These flowsheets can then be discussed between the interested parties without introducing extraneous considerations. On completion of each flowsheet the collected information can be examined to remove the less important detail and the main features transmitted to an overall flowsheet.

The size and complexity of a plant has an effect on the number of flowsheets necessary to give the picture. In some cases, especially with simple processes, it is possible to combine much information on one drawing without the danger of obscuring detail. The more complex a process the more flowsheets will be required.

To determine an economical balance two main variables have to be reconciled: the types of flowsheet required and the scale of the plant envisaged. There are roughly five types of flowsheet in common use and these may be summarised under the following headings:

TYPES OF FLOWSHEET

(1) Qualitative flowsheets

This form of flowsheet gives pictorially the sequence of

operations to which the raw materials will be subjected before they become the finished product. From this sort of flowsheet the process may be established. The type of equipment will be indicated and a very rough indication of input and output quantities given. The raw materials will be nominated, although no attempt will be made to give an exact specification. The same will apply to products and by-products. Such things as cooling water, steam, electricity and effluents will also be indicated. It would not be general practice to include instruments or control equipment on such a flowsheet. Further to this the flowsheet is produced without any endeavour to indicate relative positions or the size of one item of equipment compared with another.

(2) Quantitative flowsheets

These are logically the next step towards the determination of a process. Materials, mass and energy balances are calculated and the results indicated on this type of flowsheet. Frequently there is no endeavour to try and indicate each item of equipment other than by a square or rectangular ' box ' bearing the name of the item. These flowsheets give the complete picture of material changes through the plant. In addition flow rates, heat contents and temperature changes are also to be found.

(3) Plant control flowsheets

Instrumentation and process control gear such as valves, flow controllers, feeders, etc., are indicated here. The outline of the flowsheet is similar to that of the qualitative flowsheet. At this stage, however, it is not unusual to begin to introduce a rough scale to indicate the relative sizes of plant items. Such a scale is not in any way true. All that is intended is to convey the impression that, for instance, a main fractionating column is larger than its dephlegmator. It does not indicate by how much. The object is to begin to get the perspective of the process. On the flow lines between each vessel main control valves, feeders, etc., are drawn in and dotted lines from these items to their response source are also shown. Temperature, pressure and flow points are indicated and frequently a system of numbering and lettering appears to identify the proposed instruments with their specifications. This flowsheet has been arrived at from the study of both the qualitative and quantitative flowsheets, and with these two forms the basis for the production of an engineering flowsheet.

(4) Engineering flowsheets

The results of the quantitative, qualitative and process control flowsheets are studied and the information transferred as required to the engineering flowsheet. In addition to this the chemical engineer has decided the types and sizes of plant items, the materials of construction, the fluid dynamics and heat transfer characteristics of the process. He has considered such statutory obligations as planning and safety requirements, effluent disposal, raw materials, storage and handling and can in fact begin to see the plant in its finished state. All this is now transferred to the engineering flowsheet. The relative details such as approximate shapes of plant items, and in some cases their internals are shown on this flowsheet, including, where possible, an indication of relative heights. It is from this flowsheet that the layout of the plant will be drawn. The flowsheet has in many cases an abbreviated specification sheet as part of it. This is often referred to as the ' bottom half.' There are several schools of thought on the advisability of this, however, and it will be discussed later on.

(5) Construction flowsheets

It is often possible to make use of a flowsheet in the actual construction of a plant. By so doing a great saving on plant pipework drawings can be achieved. All that becomes necessary is to locate the main items of plant equipment on plant layout drawings and the construction team is capable of working from a flowsheet. This type of flowsheet is confined to plant erection details only. Line sizes, valve sizes, flange types and locations are shown. Materials of construction are given. Lagging particulars, gasket materials and thicknesses, straight runs for orifice plates, expansion joints and all relevant information can be included on such a drawing. There are widely differing opinions as to the desirability of working in this way. It has been used with success in the U.S. and to a lesser extent in the U.K. Much of its success depends upon the ability of the erector to adapt himself to a new technique.

It can be appreciated from the foregoing that there is a case for the production of a flowsheet for each of the applications mentioned. The advisability of this, however, must be conditioned by the size of plant envisaged. Clearly, a small and simple plant involving low capital charges could not afford the luxury of such extended design work and it will be desirable that the number of flowsheets is reduced. On the other hand, the purpose of each plant will have a bearing on the number of flowsheets desirable. A full-scale plant will always require full flowsheet coverage both for erection and running purposes, whilst a laboratory-scale plant would only require a flowsheet to record the experiment. Such a flowsheet would not be required to assist the assembly of a laboratory-scale experiment.

SCALE

To enable the scale of plant to be discussed it is proposed to break the function of each plant down to the following groups, which may be identified under the suggested headings:

Laboratory scale

The beginnings of a process, where the plant is constructed largely of glassware and the chemistry of the process is examined. Usually sufficient product is obtained to establish the recipe and to give confidence in proceeding with the project.

Semi-technical scale

Having decided on the process chemically the next step is to translate it from its glassware state to what is usually a larger rig manufactured from the materials proposed for the full-scale plant. It is at this stage that engineering and process problems become apparent and experiments to overcome them are instigated. A clearer picture is obtained of full-scale requirements and physical limitations in design make a bigger impact. Scaling up factors have received their first limited testing. From this size of plant it is often possible to obtain sufficient samples of product for process analysis to be specified. The samples may be large enough to carry out tests to verify the claims of the product. These may be done by the process designer or sent to a few prospective clients to help gauge market reaction to the product.

Pilot experimental scale

At this scale the engineering and process difficulties will be comparable with the final full-scale plant. The remedies prescribed for troubles experienced on the semi-technical scale will be thoroughly tested. The full impact of process control will be felt and operating techniques can be established with confidence for the full-scale plant. The up-

scaling factor will be sufficiently reduced to enable the step to full scale to be taken with confidence.

It is not unusual, however, to confine the pilot experimental scale to a selected portion of the plant or even in some cases to a single plant item. This step is confined to a process where much of the process is known and established and therefore only the unknowns are put through the approach stage.

Pilot commercial scale

This is, of course, the dress rehearsal of a process. The plant is completed to a small scale and embodies all the engineering, process control, plant management and other attendant requirements of the full-scale plant. At this scale all the process and engineering problems have been resolved and the plant's main function is to provide limited supplies of product to the market and to give operating experience and performance data.

Full scale

Full-scale design will have been started long before the pilot commercial plant was completed and in general the design will not be influenced greatly by the latter. Features of plant design and control highlighted by operating experience on the pilot commercial plant will find their way into the final full-scale plant, but in general these will be minor alterations. Nevertheless, they are important and may have a pronounced effect on the efficiency of the final process. They will undoubtedly affect the flowsheets.

Flowsheet requirements for various scales of operation

The final variable in assessing the economic balance of flowsheet effort will be the actual size of the plant. This in general determines the capital cost involved and on this score the reader must be the best judge of the amount of money which can be spent on design. In a sense this is the easiest decision to take and will always be the overriding condition. The diagram on page 140 (Fig. 1) is an attempt to analyse the considerations other than financial which can be taken into account when trying to arrive at the number of flowsheets required. The diagram also indicates what reasonable reduction can be made to the number of flowsheets necessary.

Laboratory scale requires only two flowsheets, a quantitative and a qualitative one, and the obvious reduction is to merge these two into one.

Semi-technical scale seldom requires an engineering flowsheet, as it is usually small in size and can be constructed on the premises under direct engineering supervision. If, however, this is not the case, the three flowsheets recommended can usefully be merged and the minimum of engineering data added to a composite flowsheet producing a simple form of engineering flowsheet.

The pilot experimental and commercial scale usually warrants all four flowsheets and, depending upon its size, often benefits from having a construction flowsheet. Reductions can be made on the experimental side by producing only two flowsheets. The first will have mainly the chemistry of the plant and the second the engineering detail. A further reduction to an engineering flowsheet containing a limited amount of chemistry can be made, but is not recommended unless the process is of a simple nature. On the commercial scale the qualitative flowsheet can be omitted as there should be no plant item changes. It is recommended that both the quantitative and process control flowsheets retain their identity, as these are the most likely flowsheets to suffer modification.

On the full-scale plant little reduction is really worthwhile. The flowsheets should retain their identity, as the number of designers engaged is usually large, and for this reason the design must fall into clearly defined areas of responsibility. Furthermore, the background work done on some of the proceeding scales will have hardened design requirements before the flowsheet stage. The flowsheet on full-scale work is a convenient form of summarising design specification and each flowsheet therefore has an individual function. Reductions can be made by omitting the quantitative flowsheet and, in the case of simple plant, two flowsheets may be capable of giving adequate coverage. From the diagram it can be seen that these two must each repeat the process control details, with the result that any change of process control would incur a lot of work.

Flowsheet production

It is difficult to suggest the costs involved in producing a flowsheet. The major portion will be in the time taken for the engineers to design it. It is worth emphasising, however, that it is not necessary for the engineer to produce more than a free-hand sketch of the flowsheet. A draughtsman should be capable of producing a well-balanced flowsheet from such a sketch and, due to his training, he will be able to execute this much quicker than the average engineer. In many firms it is in fact a tracer who does this because there is an advantage in producing flowsheets on linen rather than on paper. The average flowsheet undergoes a number of changes in the early stages and tracing paper is unsuitable for this. The wax surface of a tracing paper is removed by pencil and, although the original pencil may be entirely erased, the broken surface of the wax cannot be replaced. When eventually the finished flowsheet goes for printing the marked wax surface will produce shadows and the print will show most of the lines that were erased. This is called 'ghosting' and can on a poor print be almost indistinguishable from the pencilled line. The remedy is to produce the flowsheet on linen which does not mark so badly. The best method by far is to use a linen which will take pencil. The flowsheet can then be produced in pencil on the linen and, when finally agreed, can be inked in. Material costs are trebled by this, although these are largely recovered by only producing one linen tracing against a number of paper ones. In addition to this the final flowsheet should always be produced in ink and so the cost of a linen sheet will be incurred in any case. In storage, tracing paper will harden and after a relatively short while becomes brittle. This is not the case for linen and, if it is intended to keep the finished flowsheet for record purposes, it is essential that linen be used.

Avoiding 'flattening' effect

Too often flowsheets are drawn giving all lines the same weight. This has the effect of 'flattening' the flowsheet so that all detail becomes condensed on one plane. The intelligent thickening of flow lines relative to their importance has the effect of producing depth to a flowsheet. In the author's opinion there is no reason why the thickness of lines should not be fully emphasised to the extent of making major flow lines as much as $\frac{3}{16}$ in. thick. Clearly the maximum thickness will be determined by the number of different services shown on the flowsheet and that the most minor line should be as thin as reasonably possible. The practice of differentiating between services by producing broken lines of different sequence is a sound one but is often developed too far. A combination of full and broken lines of varying thicknesses has been found to give the best results. The production of lines of varying intensity,

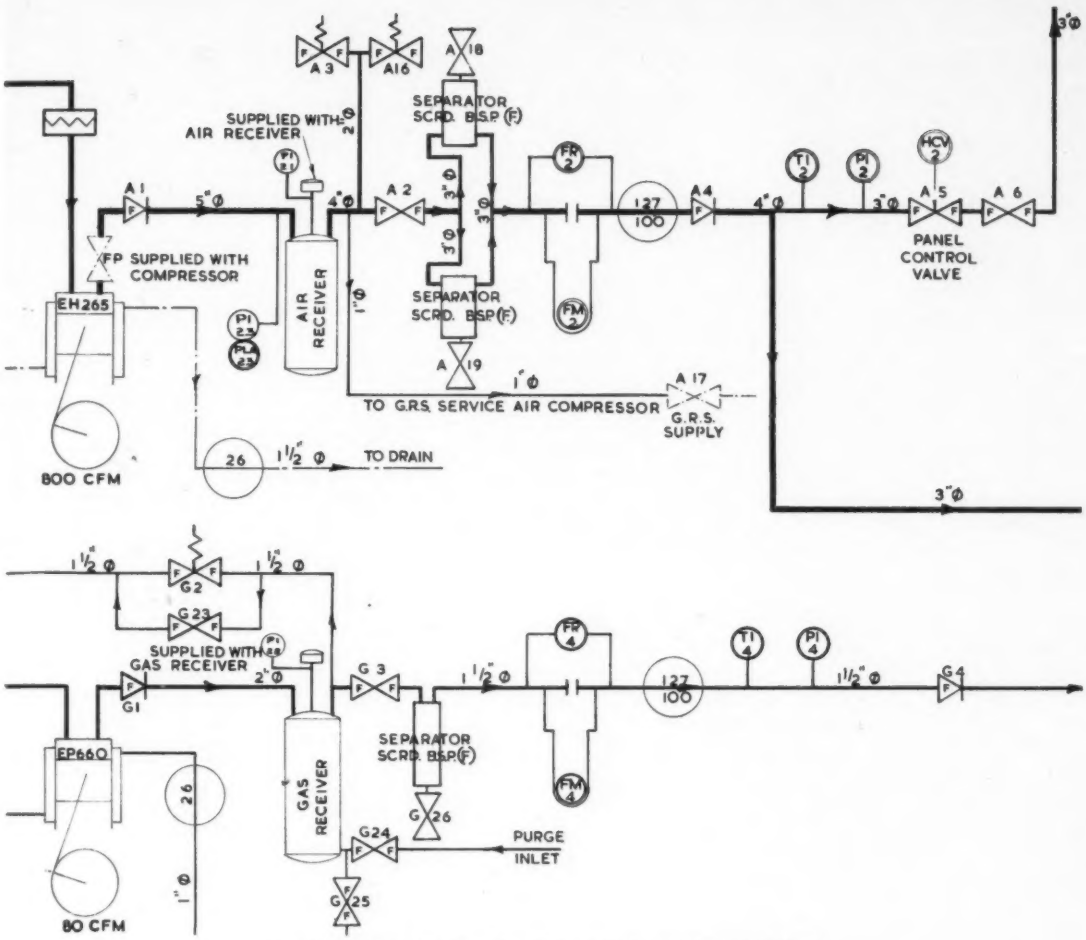


Fig. 2. Engineering flowsheet for a pilot experimental plant

however, makes it essential to use ink in the preparation of a flowsheet. Heavy black lines can only be obtained by using soft pencil, which very soon rubs off all over the drawing and for this reason should be avoided. Extra time will be taken producing an inked flowsheet, but this is well worth while if the result produces a clear flowsheet. It should be remembered also that a tracer's rate is only about two-thirds of a draughtsman's.

Bottom half

There is a division of opinion as to whether a 'bottom half' should be included in a flowsheet, the 'bottom half' being the box containing the brief specification of each flowsheet item. In the case of a simple flowsheet with relatively few plant items, this method is quite acceptable. There are two disadvantages to this system, however. Printing always takes much longer than any other operation on a drawing. It is a laborious process and all too often these days the result does not justify the effort. Furthermore, any flowsheet alteration involving the addition of flowsheet items or the rearrangement of them results in all this work being repeated. In general the bottom half of a flowsheet takes three or four times as long to produce as the actual diagram. If possible, therefore, it is desirable to divorce the two. There is a strong case in favour of producing a flowsheet as either a folder containing specification sheets with a 'pull-out' diagram or producing the diagram on one sheet and the specification on another. In each case it is possible to type the specification with a consequent saving in time. Linen or tracing paper can be typed on and, providing a new ribbon is fitted to the typewriter, the resulting prints are quite satisfactory.

Flowsheet symbols

The British Standards Institution have issued a set of recommended flowsheet symbols which are most useful for general use. In the author's experience these symbols are most suited to the qualitative flowsheet, which can be drawn to conform with them entirely. The process control flowsheet can also be made to correspond, although many instrument engineers have alterations and additions to B.S.S. 1646 which they find particularly suited to their own reference schemes. The engineering and construction flowsheets are generally better if an attempt is made to draw the plant items in outlines resembling their actual shape. Many additional symbols appear on these flowsheets (all of which should be explained in a legend forming part of the flowsheet). These are ideally a compromise between the physical appearance of the actual article and the symbol suggested in either B.S.S. 1641 or B.S.S. 974.

An engineering flowsheet

Fig. 2 shows an engineering flowsheet drawn for a pilot experimental plant. This was the only flowsheet produced after the quantitative and qualitative flowsheet stage. Only part of the flowsheet has been reproduced to enable detail to be seen more clearly. On this section it will be noticed that a great deal of information is available with particular reference to pipework detail. The plant was, in fact, constructed from the flowsheet, together with a general layout. Instruments are identified with their specification and their position is identified. If the instruments are to be panel mounted, the circles containing the reference numbers are double lined. Locally mounted instruments have only a single line circle. Valves are identified with their valve schedule and in the case of flanged valves the B.S. table of the flange (denoting its safe operating pressure) is shown as a letter in the vee portion of the symbol. Those valves with screwed connections are left plain. All line sizes are given for each section of line. Large circles on the lines themselves carry two numbers. The upper number gives the temperature of the line contents in degrees Centigrade and the lower number the line pressure in pounds per square inch gauge pressure. An indication of flow characteristics can be obtained, as each pump or compressor has a flow rate indicated on or adjacent to it.

There are clearly many additional points of information which could be included on the flowsheet. This information, however, can also be tabulated and where this is the case (such as valve types, vessel capacities and materials etc.) it has been found better to produce a set of lists and instructions which can be typed quickly and are easy to collect in a folder. The flowsheet is thereby concerned only with those details which would be difficult to convey in writing. Where the production of an orthodox drawing can be saved by adding information to the flowsheet it is well worth investing in the latter.

Conclusions

It is difficult to summarise the subject of flowsheet preparation into a list of specific recommendations. The purpose of this article has been to offer some of the salient points for consideration. It is suggested that a great deal of careful consideration as to the type and number of flowsheets can profitably be expended before embarking on the preparation of them. By careful selection an appreciable amount of drawing office time can be saved. The information regarding the project can be collected and presented in its most readable form and from a selection of flowsheets it is possible to appreciate the overall picture of the project more readily than by any other means.

Metal coatings for titanium

Two disadvantages of titanium—its tendency to seize or gall in loaded contact with itself or other materials and its oxidation at elevated temperatures—are believed to have been overcome by experiments which have succeeded in electrodepositing adherent protective coatings.

It was realised that coatings of such metals as nickel or chromium could reduce these problems but it had hitherto been impossible to get the metals to stick to titanium.

Believing that the presence of an oxide film on the titanium surface was to blame for this lack of adhesion, C. L. Stanley and A. Brenner, of the U.S. National Bureau of Standards, set out to prove their theory by removing the oxide film. The film theory was upheld—a small piece of titanium, which had been tumbled to abrade the surface and then placed in a chromium plating bath while any contact with the atmosphere was prevented, showed distinctly better adhesion than a control specimen which had been carried along but which was left open to the atmosphere.

After further experiments to apply their discovery along practical lines, a pretreatment procedure for forming a coating of titanium fluoride on the titanium surface was evolved and this, it is claimed, prevents formulation of the oxide film. When the specimen is placed in a chromium plating bath, the fluoride film dissolves away, leaving the clean titanium surface and allowing the chromium to bond directly to the base metal.

These experiments are described in *Chemical & Engineering News*, 1956, **34** (52), 6330, where it is also stated that similar procedures have been developed for depositing nickel and copper on titanium, but it has been found that these deposits have not adhered as well as chromium and have frequently blistered.

Explosion Risks in Industry

(*Concluded from page* 138)

Protection by suppression liquids

Research has shown that there is a definite time lag between the ignition of an explosive mixture and the development of maximum pressure. If the explosion can be detected and suppressed at a very early stage, the development of dangerous pressures can be avoided.

A system has been perfected consisting of an explosion detector which, through an electrical power unit, causes a blanket of finely divided suppressing liquid to be dispersed from a hemispherical suppressor. The dispersal of the suppressant is much faster than the travel of the explosion front, typical figures showing detection in 5 msec. and complete distribution of the liquid in 10 to 20 msec.

Fig. 3 shows a hemispherical suppressor[4] by Graviner Manufacturing Co. Ltd., Gosport, Hants., in which the propagation of an explosion either of vapour or dust in a closed vessel is prevented by the discharge of a suppressant fluid. The suppressant is confined in a hemispherical silver or copper container, which is ruptured by firing an internally mounted detonator actuated by a relay system controlled from a pressure-sensitive diaphragm inside the vessel to be protected. A high-speed isolation valve[5] has been developed for use in conjunction with this system. The valve (see Fig. 4) is intended to prevent flame or burning material, as the result of an explosion, travelling from one part of a plant to another, and it has wide application where explosion hazards exist.

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[2]Merchant Shipping Act, 1894, Report of Court (No. 7,951), m.v. *Reina del Pacifico*, O.N. 162,339, H.M.S.O., 1948.
[3]Made by Amal Ltd.
[4]J. M. Pirie, CHEMICAL & PROCESS ENGINEERING, 1955, **36** (9), 319.
[5]Anon., *Ibid.*, 1956 (4), 133.

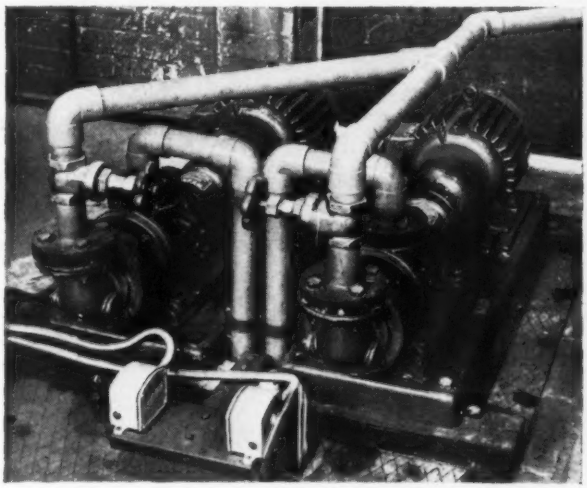
Thermoplastic Pipe in Industry

By R. L. H. Damerham
(Technical Director, Richard E. DuPont Ltd.)

Some comments on the selection and installation of thermoplastic pipes and fittings are contained in this article, which also discusses the latest methods of joining and concludes with a word on size standards.

THERE has been a considerable amount of misunderstanding regarding the use of the description ' plastic pipe ' and this has led to arguments based on different ideas of the subject under discussion. There are already in use hand-made thermosetting resin pipes which are, in effect, laminates and this branch of the industry is not the one which it is proposed to consider here. We will confine this discussion to thermoplastic materials which have been used for some time in a number of applications.

Attempts have been made to extend these applications for particular materials beyond the proper sphere in which they are really suitable, and the result has been that engineers have in many cases had disappointing experiences during their first trials of pipe-work made from thermoplastic material, and have accordingly come to the conclusion that ' plastics ' are no good. It is, therefore, necessary, if we are to re-establish a good reputation for thermoplastic pipes, to recommend them only after a detailed study of the proposed application. There are some 21 principal thermoplastic materials in use for the manufacture of pipe installations and each of these has its own characteristics—some desirable and some undesirable. It is quite definite that there is at present no such thing as a universal thermoplastic material suitable for all pipe-work.



' Durapipe ' installation carried out at the works of the Crittall Manufacturing Co. Ltd.

Selection of pipe for corrosive service

It is our experience that chemical resistances of plastic pipe vary over a much wider range than the mechanical properties and electrical properties, so that one of the first things that has to be established quite clearly before recommending a particular type of pipe is the liquid or gas which will be carried through the pipe. A further consideration is, of course, the different behaviour of these liquids or gases at high and at low temperatures.

In order to offer a reasonable service to a trade which is faced with corrosion problems in its pipe-work, a range of different materials must therefore be selected from which different types of pipe can be manufactured. In our own case we have limited this range to three types, one of which is highly resistant to solvents but not to inorganic acids, whereas another is highly resistant to inorganic acids but not to solvents. The third type is more of a general purpose type from the chemical point of view, but has outstanding mechanical properties. To produce pipe and fittings from such a range of raw materials obviously involves considerable expenditure upon dies, moulds, and stock keeping, and also involves careful training of sales staff in the different fields which open up as a result of having a variety of types of piping to offer, but this is essential if the chemical industry is to be offered a worth-while service.

Fittings

One of the principal failures of the plastic pipe industry of recent years has been its inability to offer fittings which enable an installation to be carried out rapidly and without highly skilled labour. This has been due to some extent to the considerable expense involved in laying down moulds for a reasonably complete range of pipe fittings covering all sizes. One might quote as an example a range of sizes from $\frac{3}{8}$ in. to 6 in. covering 11 sizes with say 12 different shapes in each, which calls for 132 different moulds, each of which may cost from £100 in the small size, £800 or £900 in the large sizes. Nevertheless, if it is intended to go into the business seriously this sort of expenditure has to be faced.

Developments in joining pipe to fittings

The ideal method of joining plastic pipe to fittings is with the use of a solvent cement which gives a watertight gas-tight joint simply and rapidly, and this method is already available for one or two of the most successful new thermoplastics. Unfortunately it is not suitable, at the moment, for polythene; but new methods of heat welding of the jointed area have been developed and have been found to work extremely well in practice. Threaded joints in thermoplastic materials are satisfactory in the smaller sizes, but have been suspected of being subject to cold flow in the larger sizes and

Thermoplastic fittings.

alternative methods are, on the whole, safer in sizes from 2 in. upwards.

The increased use of the slip-on type of fitting with solvent-welded or heat-welded joints calls for careful attention to tolerances in pipe o.d. and fitting i.d. which is obvious enough when it is considered that the pipe must be a reasonably tight push-in fit to secure the maximum benefit of this type of joint, and this will represent a problem to many manufacturers who have not previously had to work to such close tolerances.

The economics of plastic pipe installations are not subject to direct comparison with traditional materials inasmuch as the largest number of uses for which thermoplastic pipe would be recommended cover fields where traditional materials would not be acceptable anyway. But a factor which should be borne in mind, and certainly one which is attractive to the potential user, is the considerable saving in installation cost which he is likely to experience from the ease with which pipe and fittings can be jointed by the special methods available with thermoplastic materials.

Size standards

Our own experience has proved a theory which we have held for some time, *i.e.* that insufficient attention has been paid to the size standards to which the customer will wish to work. For the largest section of the chemical engineering industry the installation engineer will be familiar with pipe and pipe fittings to BSS.1387, which is the iron pipe size, and he is immediately discouraged if he finds that plastic pipe is to a new standard which will require adaptors of some sort or another at various stages in the installation.

For this reason we do not like BSS.1972 or the new I.S.O. standards which do not mate successfully with existing pipe systems, whereas pipe to the iron pipe sizes can easily be laid as parallel systems or replacements to existing pipe lines, thereby giving the potential customer a chance to conduct tests on a small scale before engaging himself in an expensive programme in a new material.

The subject is, of course, highly controversial and really requires a special article devoted to it, but our experience has certainly led us to feel satisfied with the progress which can be made using the existing iron pipe standard and we should require very strong evidence to convince us of the desirability of a change.

RECENT PUBLICATIONS

Fans. An illustrated 24-page publication on fans for mechanical draught has been issued by Sturtevant Engineering Co. Ltd., Southern House, Cannon Street, London, E.C.4. Various types of fan — backward bladed, backward curve, forward curve and radial bladed—are described in detail, graphs showing typical performance curves being given. The booklet also includes sections on fan output control and standard pressure measurements and definitions, and a monogram for combustion air and gas volumes.

Hydrazine solution. A 35% hydrazine solution for the deoxygenation of boiler feed water, *Zerox*, manufactured by W. H. Whiffen & Sons Ltd., Fison House, 95 Wigmore Street, London, W.1, is described in a leaflet from that company.

Solvent decarbonising. This liquid-liquid extraction process is the subject of a new 16-page booklet published by the M. W. Kellogg Co., 711 Third Avenue, New York 17, U.S. The booklet points out that the process was developed to supplement vacuum distillation and recover a substantially higher percentage of profitable catalytic feed from residues which would otherwise go to fuel or to thermal cracking.

Diphenyl. Monsanto Chemicals Ltd., 10-18 Victoria Street, London, S.W.1, have published a useful technical service bulletin on the use of diphenyl for heat transfer.

Isotopes. A fourth edition has been published of the catalogue of isotopes on sale from the isotope division, A.E.R.E., Harwell, Didcot, Berks. The principal section of the catalogue consists of a table giving the properties and availability of individual pile-produced radioisotopes. Both this section and the one on cyclotron-produced and stable isotopes have been expanded, to cover those materials which have become available since the previous editions of the catalogue.

Glycerine. The first issue of a publication dealing with the applications of glycerine has been published by the U.K. Glycerine Producers' Association, 43 Portman Square, London, W.1.

Stainless steel. The latest issue of the house magazine of W. P. Butterfield Ltd., Shipley, Yorks, includes an article, ' Today's Production Methods,' which is the third in a series on stainless steels written by the firm's chief metallurgist and welding superintendent.

Coal and chemical engineering. In its feature articles the recent issue of the quarterly *B.C.U.R.A. Gazette* (British Coal Utilisation Research Association, Randalls Road, Leatherhead, Surrey) emphasises the close relationship existing between coal science and chemical engineering. The Fifth Coal Science Lecture on ' Some Contributions of Chemical Engineering to the Processing of Solid Fuels ' by Prof. D. M. Newitt is reprinted.

WHAT'S NEWS about

★Plant
★Equipment
★Materials
★Processes

This illustrated report on recent developments is associated with a reader service that is operated free of charge by our Enquiry Bureau. Each item appearing in these pages has a reference number appended to it; to obtain more information, fill in the top postcard attached, giving the appropriate reference number(s), and post the card (no stamp required in the United Kingdom).

Electric rotation viscometer

The new *Rotovisco* rotation-type viscometer has been designed to meet the need for a modern viscometer, suitable for pure physical research as well as production control. To obtain the widest possible range of uses, it has been designed as an electric rotation viscometer, in which the viscosity values measured are converted into electric values. These electric values are then either indicated, recorded or controlled, as required.

Essentially the viscometer consists of the control panel cabinet which houses the motive elements (motor and gears), the electric control elements and the indicating device. The control cabinet is connected to the measuring head by a light, flexible cable with quick-release couplings at each end. The results obtained are read off on the indicating dial. A socket located on the control panel permits the connection of an electrically-operated recorder or regulator or to an electric line for remote control. The measuring head, which can be provided with various test outfits, actually measures the torque transmitted through the rotor shaft.

The following properties can be measured in absolute units with the *Rotovisco:* Newtonian viscosity, non-Newtonian viscosity (flow curves) and dilatation, thixotropy and rheopexy, yield limits and temperature responsiveness.

The viscosity of the material under test is obtained by multiplying the dial reading by two figures, namely the speed and calibration factors. No calibration curves are required. On switching on different speeds, the proportionality or non-proportionality of the dial scale pointer deflection is an indication of whether the material under test is a Newtonian or non-Newtonian material.

Owing to the great number of speed variations possible, flow can be checked accurately enough to plot a reliable flow curve. The static torque measurement and the very small speed of 3 r.p.m. enable a convenient determination of the yield limit of the material. By operating a switch, small pointer deflections can be magnified four times so that they can be accurately read.

Owing to the mobility of the measuring head, users of the *Rotovisco* can make various arrangements for different test procedures for special tasks, such as working under extreme temperatures or oxidation-resistant gases. Furthermore, cleansing after tests is carried out easily. Speed gear changing can be done while a test goes on. There is no need to stop the apparatus.

CPE 548

The new 'Rotovisco' rotation-type viscometer.

Air-operated pump for chemicals

The problems of pumping satisfactorily the difficult and varied liquids in the field of chemicals are legion, but in the *Neumo* range of pumps the makers are endeavouring to solve a great number of these problems within a small range of pumps.

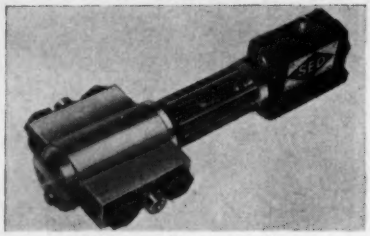
By producing an air-operated pump with no metal-to-metal sliding contact in the pump they claim to be able to compete with the range of flameproof pumps. The standard *Neumo* motor employed on all pumps has only two moving parts, both solid, and here is achieved reliability with low cost and high efficiency. This also ensures a pump which can raise a system to a given pressure and then stall, only re-starting when pressure in the system drops, a very useful attribute.

The double-acting plunger-type pump with disc valves allows liquids

C.P.E.'S MONTHLY REPORT AND READER SERVICE

to be raised to a considerable head. Standard pumps are of cast iron with alternatives available in the plunger and glands of leather, synthetics or PTFE. Pumps can be made of special materials to order, but once again the manufacturers are determined to cover the major portion of difficult liquids capable of being pumped, by marketing an inert pump entirely of PTFE.

CPE 549



' Neumo ' pump unit.

Metal mesh lines floor of electrostatic precipitators

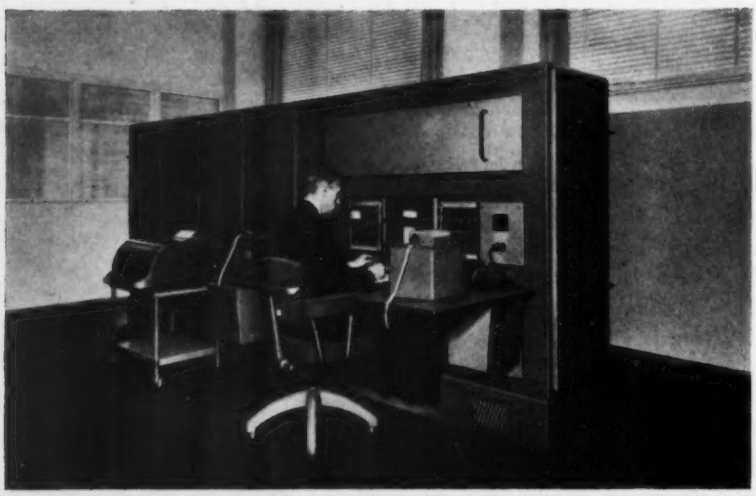
A system of metal mesh has been found to be of use for lining the floor of electrostatic precipitators by a West of England heavy chemicals manufacturer. The original problem with the precipitator base was one of insulation plus a protection against corrosive elements. It was also imperative to ensure a permanent bond between the lining agent and the steel base, bearing in mind that the whole unit was subject to considerable temperature variations from 60°C. to as much as 400°C. over relatively short periods.

The use of metal mesh would appear to have answered this problem. The method was to tack weld the mesh securely to the steel base-plate and then submerge the mesh and float the floor to a predetermined level with a ciment fondu and grog composition. By this method the steel base is less subject to thermal movement. The users state that they have suffered very little cracking of the refractory lining and very little surface distortion—allowing a much finer adjustment of the rotating cleaning plough operating internally. **CPE 550**

Electronic digital computer

A new general-purpose digital computer has been developed and the first example is in successful operation, while several more are on order. The computer is designed for solving a wide range of mathematical, engineering and scientific problems.

Like all digital computers, it is basically a machine that will calculate at high speed. It consists of five main parts—input equipment, store, arithmetical circuits, output equipment and control panel. Information is fed into the machine by means of a photoelectric punched paper-tape reader, the paper tape having a five-hole code; the instructions and data are stored in a drum coated with a magnetic oxide, on which information is recorded in the form of magnetised spots on circumferential tracks. The arithmetical circuits performing the calculations consist mainly of transistors. The output unit punches holes in paper tape under the control of the computer, and this information can subsequently be read or printed out on a teleprinter. The operator or programmer co-ordinates the whole machine, using the control panel, in such a way that instructions are obeyed correctly and in the right order.



Digital computer in use.

The computer works in the binary notation, in which each digit represents a power of two. This system has the convenient characteristics that each numerical digit has only two possible values, 1 and 0, and these can be represented simply by the presence or absence of an electrical pulse in the computer, the arrangement of the pulses representing the value of a number. This enables calculations to be performed at high speed.

CPE 551

New type plate coil

Following on the recent widespread use in the U.S.A. and Canada of flat plate coils in the plating and chemical processing industry, the introduction in the United Kingdom of a new range of *Sealcoil* plate coils has been announced. It is believed that they will find a ready application both as heating and cooling units.

Sealcoil plate coils are readily available at the moment in mild steel, but later they will be produced in stainless steel which will greatly broaden their application and use. The standard widths of 18, 24 and 30 in. are available in practically any length. They can, when required, be fabricated in angled or curved forms for special use.

CPE 552

Pinch valve

A finger-operated non-corrosive fitting for the control of fluid flow, vacua and pressure in laboratory apparatus comprises a rubber valve chest (with finger grips on the sides) containing a plastics sphere; its overall length is $1\frac{1}{2}$ in. and the bore is $\frac{1}{8}$ in.

An ordinary wash-bottle may be converted for continuous action by placing one end of the valve on the inlet tube and inserting a short glass tube in the other as a mouthpiece. The valve is opened by lightly pinching the grips on the side and air is blown in. On removal of the fingers,

the excess pressure in the wash-bottle will maintain a continuous stream of water, stopped immediately by again pinching the valve.

The valve holds a pressure difference of 750 mm. of mercury for several hours and, with a glass jet, can be used to replace the conventional spring clip on a burette. **CPE 553**

Floor-cleaning machines

Comprising three machines—a dry scrubber/polisher, a wet/dry scrubber/polisher and a drier—a new range of battery-powered floor-cleaning equipment is intended as a simple, inexpensive means of maintaining clean floors and thus of reducing the risk of accidents caused by the presence of such hazards as impacted grease and oil.

The two scrubbing machines can be adapted to clean any type of floor simply by changing brushes, an operation which can be carried out in 1 min. Brushes available range from those with 90-ton tensile oil-tempered steel bristles for scouring impacted grease deposits to polishing types with bristles of Tampico white Mexican fibre or nylon. **CPE 554**

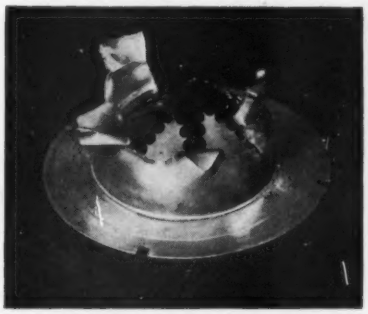
ELECTRIC MOTORS

Axially ventilated electric motors in a range covering ½ to 50 h.p. ratings have recently been introduced. These industrial motors have standard fixing dimensions to the new British Standards Specification CW(ELE) 6246. They use class 'E' insulation, which permits a temperature rise of 65°C. on 40°C. ambient temperature and they make possible smaller, lighter and cheaper machines.

The insulation makes use of plastics materials and wire enamels based on polyvinylformal and polyurethane resins, which are becoming more widely used for insulating purposes. **CPE 555**

Protection for pressure vessels

It is now common practice to use bursting discs for the protection of pressure vessels in the chemical industry, and one company, which has developed to a high degree in the past few years the use of ductile metal diaphragms for these discs, has recently started supplying discs to other companies. As a result of this practical experience and development work, bursting discs guaranteed to burst within the limits of ±5% are offered in a variety of metal including nickel, *Monel* metal, stainless steel, silver, aluminium and platinum.



Bursting disc with vacuum support which has burst.

Bursting discs are claimed to have a number of general advantages over other protective devices. They have little inertia and there is therefore very little delay in the response of a bursting disc to a pressure rise. They form a complete seal before bursting and there is no leakage. After they have burst there is no restriction to the relief of pressure. Whatever fluid is in the vessel protected it cannot 'gum up' the disc, and should a disc be damaged in any way whatsoever the effect will always be to reduce the bursting pressure, never to increase it.

One important feature of these discs is that each is preformed to a pressure greater than 90% of the bursting pressure of the disc; this improves the creep resistance of the disc considerably and it also serves as a test of the soundness of the foil being used for the disc.

Another important feature—like the former, the subject of a patent—is an interlocking system which has been devised, whereby each disc is allocated a particular combination of coding slots which coincide with pins in the appropriate holder. This system ensures that only the correct disc can be fitted to the correct holder; there is no danger of fitting a disc of too high a bursting pressure to any pressure vessel. **CPE 556**

Nitrogen cryostats

In the U.S. a new series of nitrogen cryostats, which can cool infra-red detectors to approximately −196°C., has been developed. Units are available for both laboratory and military applications.

Unlike conventional open-flask coolers, the new cryostats are completely closed recirculating systems. There is no danger of spilling or loss by evaporation. The cooling heads, and thus the detectors, can be operated vertically, horizontally or at any other desired angle.

The model 147 cryostat, designed for laboratory use, consists of two basic components—a miniature cooling head and a compressor-regulator assembly. The cooling head utilises the Joule-Thompson effect and the principle of regenerative cooling. Compressed nitrogen is passed through a miniature heat exchanger where it is cooled by nitrogen returning from an expansion nozzle. The expanded gas is recovered and returned to the compressor for recirculation. **CPE 557**

Higher tallow output from new solvent extraction plant

The first British prototype of a dehydrating and degreasing solvent extraction plant for the treatment of animal wastes utilising the Wacker-Chemie patented process has been in use for the past year. The equipment is claimed to have two important advantages: firstly, the elimination of intermediate handling and, secondly, the elimination of all offensive smells normally associated with the cooking and extraction processes.

The solvent used in this plant is perchlorethylene (C_2CL_4) which is a non-inflammable hydrocarbon solvent. The material used is raw animal car-

cass, offals and other slaughterhouse waste, including preferably not less than 20% by weight of bone.

The process consists of seven main stages: charging the raw animal material into the extractors and heating it; raising and sustaining pressure as may be required; drawing off precook fat and pumping in solvent; drawing off miscella; filtration and distillation of miscella; washing and drying residue material in extractors; and discharging the finished meal.

CPE 558

Centrifugal pump

A centrifugal pump which will handle thick stock but which does not forfeit efficiency when pumping clear water is being supplied by a British firm under licence from the Swiss inventor. They are making it available within the Commonwealth and in various other overseas territories. It is stated that, because of the unique design of its impeller, this pump will not airlock, and that aeration does not impair its effectiveness.

A feature of the pump is the small number of blades incorporated in the impeller, while there is a rapid increase in cross-sectional area of the passages due to the divergence of the shrouds. This results in the liquid within the impeller having a much lower relative velocity than in the conventional type of pump, it is claimed, with consequent less violent acceleration and deceleration during the change from kinetic to pressure energy. This, it is further pointed out, has obvious advantages when pumping thick or viscous stock, or slurries where separation of the different components is to be avoided.

The pump is made in a variety of materials and sizes to suit specific requirements, and it is already being used by paper mills as well as in other industries. **CPE 559**

Ultrasonic cleaning of plant and equipment

One of the main obstacles to the industrial application of ultrasonic cleaning has been the need to make special equipment to suit specific uses. The introduction of a new ultrasonic cleaning generator is claimed to overcome this difficulty by providing a flexible unit adaptable to a wide range of requirements.

The equipment consists of a self-contained generator, connected by cable to a transducer by which the electrical impulses are converted into mechanical vibration.

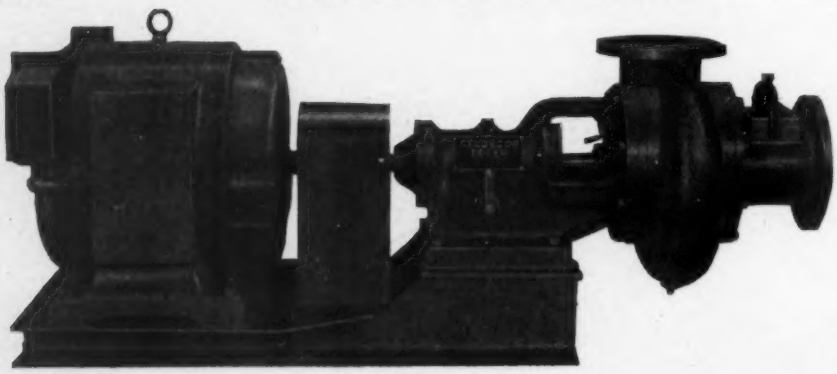
One generator, drawing only about 250 w. of electric power from the mains, can drive one standard 1-gal. ultrasonic cleaning tank or two standard ½-gal. tanks with built-in transducers. Standard immersible transducers are also available to convert existing tanks into ultrasonic cleaning installations with minimum expenditure. Measuring $2\frac{5}{8}$ in. × 8 in. × 3 in. high, two such transducers can be driven by a single Type 413 generator. By combining a number of generators and transducers, an installation of any desired power can be achieved.

Cleaning is carried out by immersing the components in the solvent normally used for manual cleaning. By using special tanks, acids can also be employed for this purpose.

The makers state that it is impossible to generalise about cleaning times, since these depend on such variable factors as the solubility, toughness and amount of soil to be removed, but processing is incomparably shorter than by hand or by boiling. Ordinary dirt due to handling can often be removed in a matter of seconds in a normal detergent, while even grease rubbed into the teeth of a smooth file is completely removed in about 20 sec.

The transducers can be operated in baths kept at temperatures of up to 170°F., which greatly expedites the cleaning action. **CPE 560**

Ultrasonic cleaning equipment. Generator, tanks and separate immersible transducer.



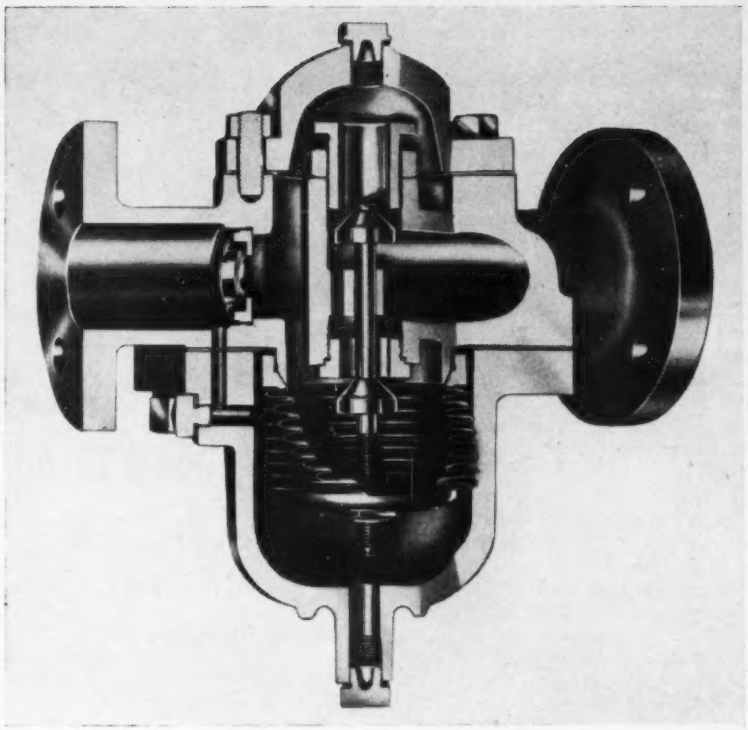
Centrifugal pump with novel design of impeller.

Automatic flow control

Of special interest to industries considering the possibilities of automation is a device which is claimed to simplify flow control and provide a low cost technique. It combines a flowmeter and controlling valve, both operated by the pressure energy of the fluid. The *Flostat* is thus a self-acting flow controller; no electric or compressed-air supply is required for its operation.

It resembles a valve and fits directly into the pipeline. In its simplest form it is non-adjustable, being factory set for control of a certain fluid at a desired flow rate. In operation it delivers fluid within 1% of the set rate irrespective of variations of fluid pressure either upstream or downstream from the installation. For volume control the *Flostat* need only be used with a timing device and shut-off valve. It can be made in materials suitable for handling a wide range of industrial fluids.

An important design feature is the double-beat valve which is pressure balanced so that high sensitivity and response speed are achieved. Recovery time is often 0.5 sec. and rarely exceeds 3 sec. **CPE 561**



Sectional view of the 'Flostat' flow controller.

A rust-proofing liquid metal

Rust-proofing liquid metal has been developed which can be applied as easily as paint to give a tough, durable, non-poisonous, electrically conductive metal coating. This is claimed to produce rust-proofing qualities comparable to those given by hot-dip galvanising, but at less cost.

The substance consists of atomised, anodic metal suspended in a special, self-curing plastic medium. Of particular interest to chemical engineers will be a heavy-duty grade for use where abrasion is severe or where strong chemicals or solvents come into contact with the coating. It is temperature resistant to 300°F. and has found use in such applications as steelwork in chemical works, gas works, acid storage tanks, fertiliser spreaders and galvanising plants. **CPE 562**

No kinks for hoses

The introduction of a completely new anti-kink high-pressure swivel coupling will interest users of high-pressure hose. It is well known that kinking, apart from the inconvenience caused, will also shorten the useful working life of a hose, and the fitting of this swivel coupling, it is claimed, will overcome the problem.

The coupling has been designed to join either hose to hose, or hose with suitable attachments to rigid valve and, in operation, gives an unlimited amount of free turning. Torsional strain is completely eliminated, and the action of the coupling in swivelling freely under pressure prevents kinking. The coupling will be guaranteed leak-proof under pressures up to 2,000 p.s.i. and in actual fact the manufacturers invariably test the coupling under pressures up to 6,000 p.s.i. with equally satisfactory results. No lubrication, adjustment or attention of any kind is required and the obvious saving in labour costs by eliminating work stoppage for the purpose of straightening hoses is an important factor.

Kinked and tangled hose lines have also been a contributory cause of accidents as the result of a trip or fall, and this gives yet another good reason for the adoption of a safeguard of this nature wherever practical. The swivel coupling is not confined solely to manufacturers or users of hose but has many other uses, for example connecting feed lines to rotating equipment, and in conjunction with hydraulic and pneumatic equipment, etc. **CPE 563**

Pneumatic control valves

An improved version of the slide valve as used to control compressed-air and low-pressure hydraulics forms the basic unit of a comprehensive range of control valves which is now being manufactured. The slide valve is noted for its long working life, yet, the makers claim, a much improved performance is obtained from this latest design due to its extreme simplicity, few working parts and limited valve movement.

Based on the linear-slide-valve principle, the valve consists of a body housing a simple balanced piston which traverses the valve slide across the lapped ported face. This piston carries low-friction patented seals in

a plain bore of honed finish. (When arranged for reversal by pilot air signal the valves are fitted with synthetic rubber buffer rings to absorb the inertia of the moving piston to provide a shockless reversal.) All working parts are produced from entirely non-corrodible materials of either copper alloy or stainless steel.

The basic unit is arranged for four-way control of either positive, self-reversing or self-centring action. The latter is available having its ports either blanked or open to exhaust in the neutral position. These four different types can each be supplied suitable for hand, foot, pad, mechanical, automatic or semi-automatic control or in combinations of these various styles. **CPE 564**

Acid-resisting cement

Based on *Epikote* resin, an acid-resistant cement which is now being produced is usable in conditions of wet, cold or heat, the makers claim, without loss of quality or complication in handling.

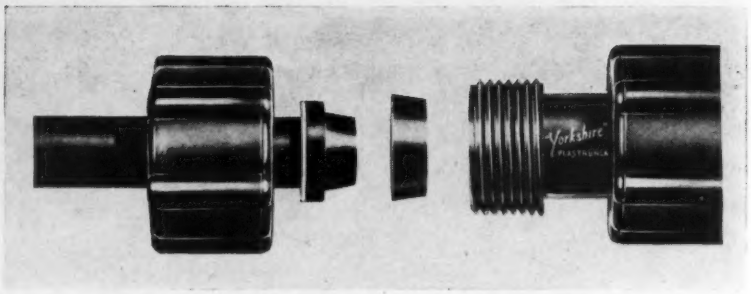
Its chemical resistance and excellent adhesion, derived from the *Epikote* resin constituent, make it particularly suitable for such work as the reinstatement of factory floors. Little preparation is needed to dry out the crevices and remove all the previous cement.

The work can be done during a short shut-down period—say, over the weekend—and the application of the trowelling compound does not call for specialist knowledge or techniques. **CPE 565**

Automatic voltage adjustment

Electronic tap-changing transformers have been developed to ensure that the output voltage of electrical and electronic devices always remains within ±5% of the declared value for input changes of as large as –20% to 10%. This range covers all likely variations in the mains voltage, it is claimed.

The automatic tap changer is made in two basic sizes, rated at 2½ and 5 amp. when the voltage is 200 to 250. For 100- to 125-v. models, the current rating is double, *i.e.* 5 and 10 amp. All types are available as chassis or as complete units, and a range of accessory transformers is supplied. **CPE 566**



'Plastronga' reducing straight coupling assembly.

High-strength polythene tubing

Following the successful introduction of *Plastronga* polythene fittings and *Polyorc A* polythene tubing, the manufacture of *Plastronga* high-strength polythene tubes, made in the same material as the fittings, has begun. Their good rigidity and strength make for neat appearance, while the few pipe clips needed mean quick and cheap installation work. The spacing of the clips, it is claimed, can be double the distance recommended in B.S. 1972.

These tubes are available in 18-ft. lengths, in ½ to 2 in. normal gauge sizes, making them especially suitable for cold-water plumbing services in buildings. They are also available in 50, 100, 200 and 500 ft. coils in ½ and ¾ in. sizes only. The tensile strength of the tubes is approximately 3,600 p.s.i., compared with 1,400 p.s.i. required of ordinary polythene tubes to B.S. 1972. The tubes can be flanged or can be supplied pre-flanged. Pipe clips for use with them have been developed in black, rigid PVC.

The rigidity of the tubes does not permit the forming of acute bends while cold. The minimum radius while cold should not be less than 10 to 12 times the o.d. of the tube, but if heated by a carefully applied blow-lamp flame, bends down to a radius of six times the o.d. of the tube can be made. **CPE 567**

Deioniser

A portable and self-contained deioniser unit, specifically designed for the research laboratory and pilot-scale production, provides purified water, equal to three distillations in quartz (conductivity water) from tap at flow rates of 75 l./hr. The water is free

CHEMICAL TANK AND STAND OF PLASTIC

The great scope for compound laminates as structural materials in the chemical engineering industry has recently been demonstrated by the completion of this large storage tank and stand. The tank, which is 8 ft. × 4 ft. × 6 ft., is designed to accommodate the highly corrosive zinc chloride used by the Ever Ready Co. (Great Britain) Ltd. in battery manufacture. The chemical resistance of both tank and stand derives from the use in their construction of compound laminates made from special epoxide and polyester resins, reinforced with glass-fibre materials.

When full, the stand weighs about 10 tons. The stand itself is 10 ft. high and is a properly stressed engineering structure, the good inherent rigidity of the main supports being further enhanced by cross members. **CPE 568**

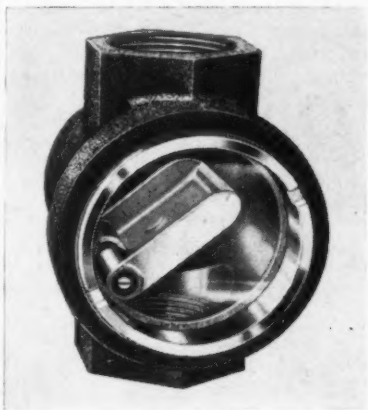
from toxic metals, silica, chloride, sulphate, ammonia and carbon dioxide; *p*H value is 6.6 to 7. Specific resistance is 2 million ohms plus.

Two models are available. Where the effluent is required for less critical work, no conductivity meter is provided. The resins embody a colour indicator which shows exhaustion point. Where accurate quality control of effluent is essential, an integral conductivity meter is provided.

For laboratory production of cathode ray tubes and valves, transistors and other electronic components, this model provides conductivity water from tap. **CPE 569**

Vane-type flow indicator

A new sight flow indicator is a single-window, vane-type indicator for use with clear or translucent liquids.



Flow indicator.

'Resilon' vacuum filter.

It is ideally suited for use in cooling water lines to transformers; jacket water lines for diesel engines; in oil lines to hydroelectric turbines and other equipment.

The vane, visible through the glass, is spring actuated—assuming a position at right-angles to the centre line of the pipe when there is no flow, and moving at an oblique angle when liquid is flowing. The position of the vane provides an approximate indication of the quantity moving through the pipe.

The indicator can be supplied for the following pipe sizes: $\frac{3}{4}$ in., 1 in., $1\frac{1}{4}$ in., $1\frac{1}{2}$ in. and 2 in., and with springs of varying tension, to permit their use on either vertical or horizontal pipelines, and so designed that the flow may be either from the right or the left, upwards or downwards. **CPE 570**

TECHNICALITIES WITHOUT TEARS

Is it possible to express technicalities in simple comprehensible language? Can a scientist be taught to say or write what he wants to convey, in words which people of normal commonsense can understand? These were the questions which prompted a young barrister and a solicitor to set up, four years ago, courses to teach executives in industry to write and speak. There are now some 200 firms who send executives regularly to their courses. The managing director of one firm, it is claimed, went so far as to state that it was the best investment his company had ever made.

The courses are small and friendly. There is no lecturing—only a few short, simple talks to establish principles. Then the members of the course apply the principles to their own problems, getting practical experience in writing and speaking in the process, gaining confidence and helping each other.

Courses to concentrate upon how to present technical information—reports, brochures, articles and lectures—are a comparatively new development. They will run for ten working days and will cover functional English and how to use it, writing technical reports and memoranda, technical papers, brochures and articles, lecturing and presenting technical information to conferences and committees. **CPE 571**

Vacuum filter in new material

Vacuum filters, made from a new type of synthetic resin-bonded fibrous reinforced material known as *Resilon*, are now on the market. They are claimed to have such advantages as immunity from 'hair cracks' and their ancillary disadvantages, stability under sudden changes of temperature, lightness in weight, yet being sufficiently strong and resilient to withstand vigorous manhandling and a long working life.

The chemical duty of *Resilon* is generally between *p*H 2 and *p*H 12 and it is estimated that articles of this kind made in this material are only a third of the weight of their equivalent in steel.

The vacuum filter, weighing 102 lb. complete, is constructed in five units—a top and bottom section, a perforated plate, and gaskets. The top section comprises a cylindrical cast of $\frac{3}{16}$-in. nominal thickness with flanged-out ends, having a total liquid capacity of 30 gal.

The bottom section consists of a spherical and cylindrical casting with a side outlet for connection to a vacuum circuit which is protected against the intake of filtrate by a cast hood of *Resilon* 584. This unit, like the top section, is otherwise constructed in compound laminate grade 584/610. The bottom outlet of $1\frac{1}{2}$-in. n.b. is flanged and drilled B.S.T.D. and is sloping to prevent trapping of filtrate. Three tubular legs are cast integrally with this section.

The perforated plate is 27-in. diameter, having perforations $\frac{1}{8}$-in. diameter at $\frac{1}{2}$-in. square pitch within a 20-in.-diameter circle and constructed in $\frac{1}{8}$-in.-thick grade 584. **CPE 572**

Multi-service gland packing

The ordering, stocking and fitting of gland packings is an expensive and complicated business when it is necessary to hold large numbers of different types and sizes in stock for a variety of services.

A new gland packing, *Superlon*, offers a means of greatly simplifying the ordering, stocking and fitting of gland packings over a wide range of services.

It is a multi-service packing equally suitable for water, steam, oils and solvents, or chemicals and acids in

moderate strengths and concentrations. The temperature range is from –40°F. up to 500°F.

According to the makers, *Superlon* is comparable in price with any high-grade general-purpose packing, but

Gland packing.

has the widest range of application of any so far produced. It is also very flexible, so that any one spiral of a particular section will accommodate several shaft sizes, thus reducing the number of diameters of spiral it is necessary to stock.

The chemically inert plastic *Fluon* is used in the manufacture of this packing. Neither metallic elements nor graphite is included and the packing can, therefore, be used on services handling food products. **CPE 573**

PVC glove cabinets

Problems involving the handling of chemicals which lead to allergies and troubles with the operators are now being overcome to a large extent by the use of simple, flexible glove cabinets. They have been designed as a cheap substitute for the rigid glove cabinets manufactured for use with radio-isotopes, and are for use where negative pressures are not required for safety.

The present flexible cabinet is clearly of particular importance where manipulations of biological or chemical material have to be made in an atmosphere free from oxygen or where absolute sterility is required.

It has to be maintained at a very small positive pressure to keep its shape and this is done by feeding in nitrogen or another inert gas or sterile air and any leakage merely acts as ventilation.

The entire compartment is made from PVC sheet, welded by special high-frequency welding machines. The gloves are also made from PVC sheet and are welded into position. This material is very inert to most chemicals and, in the thicknesses used, is very resistant to tearing.

One of the great attractions of this whole system is the use of the special moulded PVC zips. These have double interlocking moulded ridges and when zipped up are completely airtight except for a small leak at one end of the zip. The main zip encircles three sides of the square and permits the entire top to be folded away so that base trays, retort stands and any large apparatus can be placed and adjusted without using the gloves at all, or the air lock.

When everything is ready, the main zip is done up and can be internally sealed if required. Materials for operation can be inserted from time to time through the air lock, which has similar zips of a small size on the inlet and outlet walls. **CPE 574**

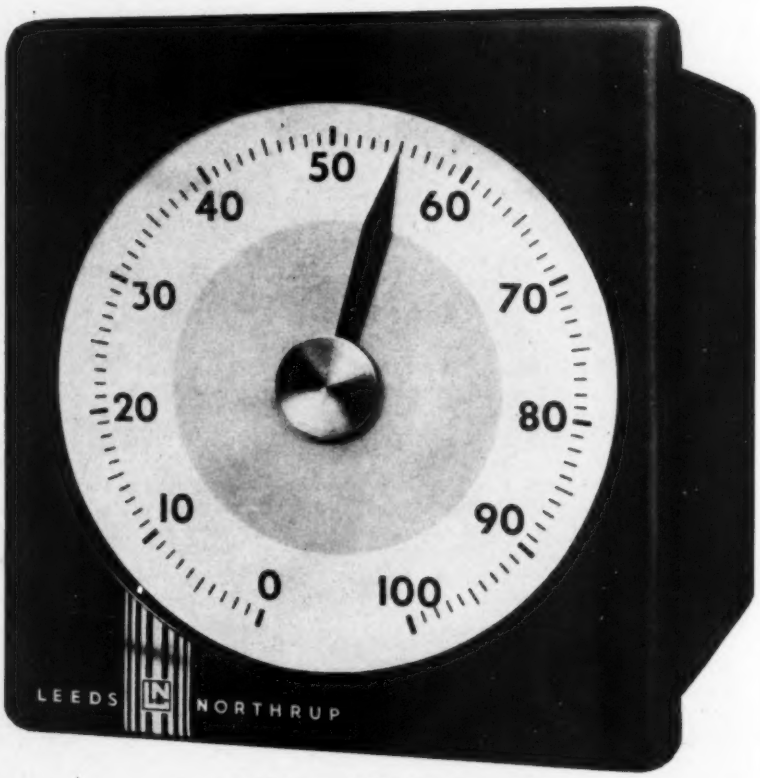
Electronic temperature measurement

Now in production, the latest model in a range of electronic instruments has been specially designed as a simple, low-cost null-balance potentiometer for less complex applications.

The *Speedomax H* has plug-in components, simple range changing and external terminal boards. It can be installed wherever it is required, being moved simply by extending the leads—variations in ambient temperature along leads do not affect efficiency, it is claimed, and there is no need for re-calibration—the instrument checks itself automatically.

Dimensionally it is compact, the cast aluminium case being only 12 in. high and 11 in. wide by 11 in. deep, yet charts are easily legible from a distance.

It is available at present for temperature measurement only. There is a choice of various models: for indicating, recording and controlling, round chart or strip chart, and many forms of proportioning control—electric and pneumatic—are available. **CPE 575**



'Speedomax H' indicating model.

New Mechanical Handling System for High Alumina Ceramic Production

A SYSTEM of mechanical handling of more than usual interest has been brought into operation at the Treforest (South Wales) works of K.L.G. Sparking Plugs Ltd., where high-alumina ceramic is produced not only for sparking plug insulators, but for an increasing variety of special purposes.

Extreme accuracy of weight and measurement at all stages and scrupulous cleanliness were of even greater importance than time and labour saving, but the new system has achieved all these conditions and, in fact, reached even higher standards than those which existed before the mechanisation programme was embarked upon.

The process of manufacturing the special K.L.G. insulating material, in common with other ceramic processes, involves milling or grinding in ball mills, filter pressing and subsequently granulating or otherwise preparing for fabrication of the required articles. The K.L.G. ceramic, however, differs from most others in having a calcining process in its early stages.

After calcination, a screw conveyor takes the material to some storage hoppers in an adjoining shop. Here there is automatic feed to micronisers, and the ceramic is bulk weighed in loading hoppers before being hoisted and fed into ball mills for the secondary milling operation.

Laborious handling eliminated

When manufacture of it began at the Treforest plant certain limitations were imposed by the fact that production had of necessity to be carried out with equipment previously used for making another type of ceramic, now superseded. Aluminium hydrate (Al_2O_3, $3H_2O$) was weighed by hand into rubber-lined ball mills and ground wet for the appropriate period. The liquor was then run to a filter press *via* a pump and the filter cakes transported to a local factory where periodic kilns had been hired. After loading into saggars the kilns were lit and fired and after cooling again were unloaded and the calcined material transported back to the K.L.G. works for micronising. The micronisers were hand fed and the product then weighed into ball mills again for further milling with other ingredients. There followed filter pressing, drying in ovens, pulverising (hand feed) and final mixing in batch mixers, from which the material was taken by hand and hand fed to granulators.

It is apparent that in any system of mechanisation or mechanical handling the accuracy of weighing and cleanliness was of paramount importance and in this respect the results obtained by the new methods have been highly satisfactory.

The new system

Aluminium hydrate is now unloaded directly from the delivery truck into the hopper of a vertical elevator, which transfers it by way of a horizontal screw conveyor to overhead storage hoppers. All equipment is made of aluminium, so that any contamination through abrasive wear will be converted to Al_2O_3 (oxide) during calcination. Below the hoppers are valves which control the flow of material into an automatic weighing machine with an accuracy of .01%. The ball mills are also positioned under the hoppers, so that the preweighed quantity can be fed directly to the mills.

The filter pressing operation is normal, but the filter cakes are loaded into saggars on site, the saggars being presented to the operator by means of a roller conveyor. A continuous tunnel kiln has been installed adjacent and the saggars are fed through this kiln for calcination, after which the material is tipped into another vertical elevator and the empty saggars placed on the roller conveyor which presents them for refilling.

The calcined material is conveyed *via* screw conveyor to an adjacent shop into storage hoppers which have the micronisers associated with them, so that automatic feed to the micronisers is achieved. The material is then bulk weighed and hoisted over the ball mills for the secondary milling operation. After filter pressing again and drying in ovens on pallets the material is placed in hoppers which self-feed the pulverisers. The final mixing is done in an overhead batch mixer with self-feed and self-empty and the mixed material falls into hoppers associated with the granulators, which are then fed automatically.

The effect of this mechanisation has been to improve quality and, without causing redundancy, to reduce a labour force of approximately 20 men (plus part-time labourers) to six men. This does not include the operators for the new kiln who, through streamlining and motion study, now perform this work in addition to their normal duties on other kilns, so no additional kiln labour has been needed.

Nomogram:

Viscosities of Dilute Carbonated Aluminate Solutions

By D. S. Davis

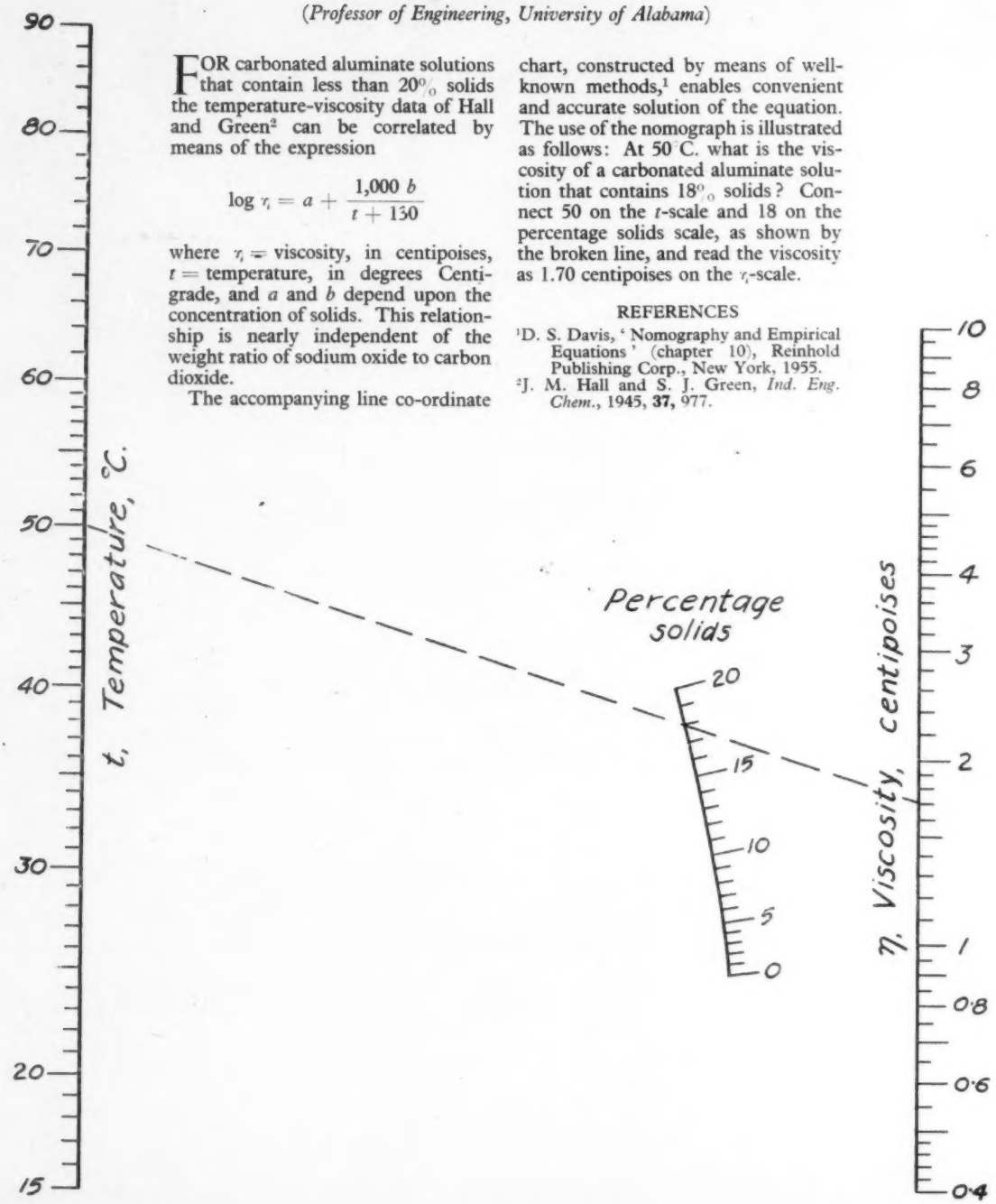
(*Professor of Engineering, University of Alabama*)

FOR carbonated aluminate solutions that contain less than 20% solids the temperature-viscosity data of Hall and Green[2] can be correlated by means of the expression

$$\log \eta = a + \frac{1{,}000\ b}{t + 130}$$

where η = viscosity, in centipoises, t = temperature, in degrees Centigrade, and a and b depend upon the concentration of solids. This relationship is nearly independent of the weight ratio of sodium oxide to carbon dioxide.

The accompanying line co-ordinate chart, constructed by means of well-known methods,[1] enables convenient and accurate solution of the equation. The use of the nomograph is illustrated as follows: At 50°C. what is the viscosity of a carbonated aluminate solution that contains 18% solids? Connect 50 on the t-scale and 18 on the percentage solids scale, as shown by the broken line, and read the viscosity as 1.70 centipoises on the η-scale.



REFERENCES

[1] D. S. Davis, 'Nomography and Empirical Equations' (chapter 10), Reinhold Publishing Corp., New York, 1955.

[2] J. M. Hall and S. J. Green, *Ind. Eng. Chem.*, 1945, **37**, 977.

Rayon Pulp from Wood

The £8½-million rayon pulp factory of the South African Industrial Cellulose Corporation (Pty.) Ltd. at Umkomaas, Natal, produces rayon pulp from timber by means of a complicated chemical process. This process, and also the methods of filtering the large quantities of water used in it, are described below.

THE South African Industrial Development Corporation (Pty.) Ltd. (Saiccor), which was established to manufacture rayon pulp at Umkomaas, Natal, was sponsored by Snia Viscosa of Italy, Courtaulds Ltd. of Great Britain, and the Industrial Development Corporation of South Africa Ltd., each company providing one-third of the share capital of £6 million. Since then the Italian firm has disposed of its financial interest to Courtaulds Ltd., though the arrangements under which Courtaulds and Snia Viscosa will each purchase one half of the output of Saiccor's factory are not affected.

The British and Italian firms supplied the technical data and skilled personnel for the factory process, some 200 Europeans being employed. The common bluegum, *eucalyptus saligna*, grown in Zululand, is providing the basic raw material for the factory. Climatic conditions in Zululand encourage the rapid growth of trees, the annual increments estimated to average up to 400 cu.ft./acre of pulpwood. The company has invested about £1 million in plantations in Zululand, where it has about 38,000 acres under bluegum, and during the next five years it plans to plant out the 8,000 acres it owns in the Natal Midlands.

Purchases in the Union of other materials required for the factory's production processes, such as limestone, coal, chlorine, caustic soda and hypochlorite, are estimated to amount to over 50,000 short tons p.a., plus another 12,000 short tons of pyrites from Northern Rhodesia.

Currently the entire output is being exported and this policy is to be continued for the next few years.

Conversion process

Basically, cellulose sulphite pulp is produced at Umkomaas by the complete elimination of the lignin in the timber and the partial elimination of the hemicellulose, which is effected by the action of sulphite liquor. As 3½ tons of the bluegum timber contains 35% of moisture, it only provides about a ton of pulp. The sulphite liquor is being produced by the interaction of limestone slurry and sulphur dioxide.

As the logs arrive at the factory they are stripped of bark and passed into the chipping plant along a flume and short rake-apron conveyor, which has proved to be more economical than the long conveyor system. In the digesters, the chips are delignified by the sulphite liquor to yield impure cellulose pulp and soluble lignin sulphates, the latter drained and later poured into the sea as effluent.

Meanwhile, the impure cellulose pulp is washed, screened, rewashed, chlorinated (Cl_2), washed again, neutralised with caustic soda (NaOH), washed again, bleached with sodium hypochlorite (NaOCl), washed again, acidified with sulphur dioxide (SO_2), and washed again.

The picture above gives a general view of the Saiccor factory at Umkomaas.

This purified white pulp is thickened in the special rotary filters before being fed to a Foudrinier machine, in which it is formed into sheets and dried, the sheets then being ready for cutting, baling, weighing and despatch.

Providing water

It will be seen that to convert trees into pulp requires a great deal of water and the needs of the Saiccor factory for the actual conversion process, as well as for the generation of steam, average 15 million gal./day. It was because the river at Umkomaas could provide water at this rate, together with the fact that Umkomaas is only a few miles away from the port of Durban, that this particular site was chosen in preference to other points where the water at least was plentiful.

Heavy rains deep in Natal bring the floodwaters rushing along the rivers to the sea, carrying along a tumbling mass of debris, some of it of large size and, if this were allowed to enter the comprehensive pumping system, extensive damage would be done. This has been guarded against by the provision of a travelling-band screen which screens the whole of the water supply from the Umkomaas River to the pulp plant. The screen has an effective screening width of 4 ft., an overall height of 52 ft., and is rated for a normal flow of 21 million gal./day with a minimum submergence of 6 ft. 6 in.

Another feature at Umkomaas is a chemical dosing plant to pre-treat the water from the river before it goes

into the sedimentation tanks and filters. This plant is also designed to cope with 21 million gal./day of water under the worst flood conditions.

Filtration plant

Filtration plant includes 16 rapid gravity filters, each designed to handle 1 million gal./day of water. This plant incorporates the Moore *Hi-level* surface sweep system of filter washing in conjunction with jet agitation system of washing.

It is possible to work the filters either automatically or manually for backwashing and other operations. In the automatic operation the backwash cycle begins with the loss of head in the rapid gravity filter reaching a set height, with the loss of heat setting adjustable. It is planned to make the fullest use of automatic operation, because by that means there is much saving of backwash water, with at the same time only a minimum of trained attention required. As it is possible to backwash any of the filters without any use of manual labour, there is no need for continual supervision of the filters.

The *Hi-level* system as applied to this plant has a filtering media that is not carried to waste with the backwash water, and at the same time the residual floc remains in the bed of the water of the filter after backwashing, so that immediately this process has been completed the filtering film is replaced. The advantage lies in the reduction of slow starts and the avoidance of treated water entering the clear-water chamber. At this cellulose plant it is essential for the water at all times to possess a high clarity so that impurities cannot enter, with the consequent risk of a consignment of material being ruined.

Instrumentation

The instrumentation of the water works, much of the equipment for which was built in South Africa, includes various flowmeters, *p*H indicators for the purified and raw water supply, and two level meters equipped with high- and low-level audible and visible alarms, and audible cut-out is possible. The factory reservoir has been provided with a main alarm, and there are repeat alarms at the pump intake at the river and also in the turbine control room in the power station.

Steam plant

Because this cellulose plant demands the extensive use of steam, it was decided that the necessary power would be generated on the spot. To this end two 3,500-kw. turbines have been installed, and the high-pressure steam they use is subsequently available for service in the factory at a lower pressure. The steam plant at the cellulose factory was erected by Babcock & Wilcox of Africa (Pty.) Ltd., and consists of three of this firm's bi-drum boilers, which were made in Milan, Italy. Each of the three boilers has a maximum continuous evaporative capacity of 66,000 lb./hr., an operating pressure of 665 p.s.i. at the superheater outlet, and an operating steam temperature of 860°F.

The Permutit ion-exchange plant is providing make-up water of distilled quality, without heat, to boilers working at 665 p.s.i. The existing rate of supply is 25,000 lb./hr., but the plant now installed can supply up to 500,000 lb./hr. The water so produced has an electrical conductivity of only 4 microhms/cc. This plant is equipped with an audible warning device that sounds off the alarm the moment the water falls below the designed quality.

Makers and suppliers of equipment

Among companies which supplied or manufactured equipment for the project were: Babcock & Wilcox of Africa (Pty.) Ltd.; Edward L. Bateman Ltd., Johannesburg; F. W. Brackett & Co. Ltd., Colchester, England; Candy Filter Co. Ltd., London, England; Cape Asbestos Insulations (Pty.) Ltd.; Dowson & Dobson Ltd., Johannesburg; Electroflo Meters (Africa) (Pty.) Ltd.; and Permutit Co. Ltd.

British Standards

Tests for welders (B.S. 2645: 1956, 10s. net, ' Tests for use in the approval of welders, Part 2: Manual metal arc and oxy-acetylene welding of mild steel and low alloy steel pipelines and pipe assemblies '). The purpose of this standard is to make available a series of agreed standard tests, one or more of which can be selected for assessing and testing the capabilities of a welder. The tests in this part cover various thicknesses of tube, normal forms of joints and various welding positions.

Smoke control (B.S. 2811: 1957, 3s. 6d. net, ' Smoke density indicators and recorders,' and B.S. 2741: 1957, 3s. net, ' Recommendations for the construction of simple smoke viewers '). The first of these standards deals with smoke density indicators and recorders, while the second suggests a number of forms of very simple instruments which will be found useful in certain circumstances to supplement the information given by photoelectric instruments of the type specified in the former standard.

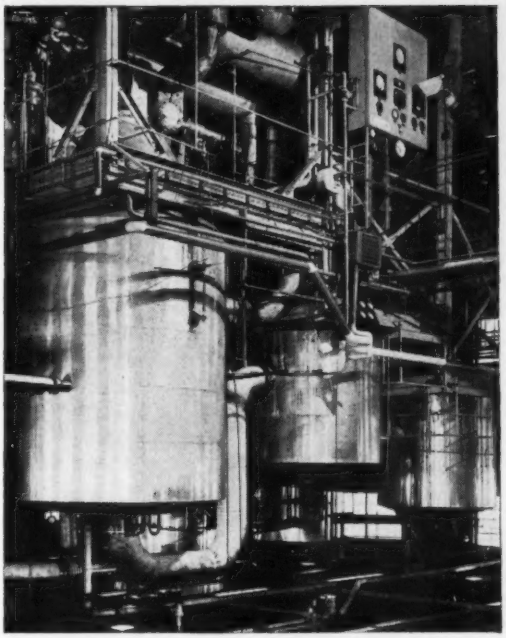
Solvents (B.S. 507: 1956, 508: 1956, 551: 1956, and 553: 1956, 3s. each, ' Ethanol,' ' *n*-Butanol,' ' *n*-Butyl acetate,' ' Ethyl acetate '). These are the first four of a proposed series of revisions of standards for solvents and allied products. Changes in the specification limits reflect improvements in the qualities of material now available and considerable clarification has been achieved in the details and presentation of the test methods.

Testing plastics (B.S. 2782: 1956, 10s. net, ' Methods of testing plastics, Part 1: Effect of temperature '). This standard is the first part of what is to become a series of test methods used by the plastics industry for assessing the quality of its products and was prepared with the full collaboration of the British Plastics Federation. This first part contains a group of test methods which can reasonably be considered to be of use in assessing the effect of temperature on plastics and associated products. Included in this group are tests for properties such as crushing strength after heating, deformation in bend under load at elevated temperatures, melting point, cold bend temperature, shrinkage and after-shrinkage and loss in weight on heating.

Aerial bactericide assessment (B.S. 2796: 1956, 3s. 6d. net, ' Technique for the preliminary assessment of aerial bactericide '). This technique is intended as a method of determining whether a product is suitable for further investigation as aerial bactericide, but it will also be found useful by manufacturers of aerial bactericides for the purpose of quality control in factories.

Ammonia Pressure Leach Process Recovers Metals from Ore Concentrate

BIG CANADIAN PLANT COMPLETED



Copper boil unit at Fort Saskatchewan.

COSTING some $24 million to construct and equip, a new chemical metallurgical plant has recently been completed at Fort Saskatchewan, Alberta, by Sherritt Gordon Mines Ltd. which, by the use of an ammonia pressure leaching process, successfully produces high-purity nickel, copper and cobalt from nickel concentrate at a cost appreciably lower than if conventional smelting and electrolytic refining were used. An ammonia plant is also integrated with the metal recovery plant whereby 75 tons/day of anhydrous ammonia can also be produced, based on natural gas.

As installed at Fort Saskatchewan, the process involves treating the nickel-copper-cobalt iron sulphide concentrates under pressure with air and ammonia to dissolve the valuable metals and most of the sulphur, leaving the iron and other impurities in a tailing which is discarded. The copper is first separated from the solution as sulphide by a boiling operation, the nickel is then precipitated by hydrogen under pressure, the cobalt removed and purified, and the end solutions evaporated to produce ammonium sulphate.

Faced with the knowledge that their copper-zinc-gold mine at Sherridon, Manitoba, was nearing exhaustion, Sherritt Gordon Mines have, in recent years, been developing a nickel-copper mine at Lynn Lake, about 150 miles north of Sherridon, and a proven reserve of over 14 million tons of ore containing 1.223% nickel, 0.618% copper and additional cobalt values has been established there. The original Sherridon mill and mine equipment has now been transferred to Lynn Lake to produce 2,000 tons/day of ore. At the same time, a metallurgical research and development programme has been undertaken to work out an economic treatment process involving the lowest possible production cost. Laboratory and pilot-plant stages have now resulted in the new Fort Saskatchewan treatment plant designed to treat 240 tons/day of nickel concentrate, this being approximately comprised of nickel, 10 to 16%; copper, 1 to 2%; cobalt, 0.2 to 0.4%; iron, 35 to 40%; sulphur, 28 to 34%; insol., 8 to 14%; precious metals, less than 0.02 oz./ton.

The plant

Built by Chemical Construction (Inter-American) Ltd., the new plant comprises six sections: leaching, copper separation, unsaturated sulphur oxidation and sulphamate hydrolysis, nickel metal reduction, cobalt recovery and ammonium sulphate recovery. Although a satisfactory cobalt recovery process had been developed and this section was put under construction, information about the completion of the plant was not available at the time of preparing this article.

Since they either receive or deliver solid materials in large quantities, the leaching, metals recovery and ammonium sulphate buildings of the plant adjoin the railway sidings and provision has been made for the expansion of all the processing buildings. For the economical transmission of steam, electricity, water and compressed air, the power and water treatment plants have been centrally sited relative to the processing departments, as also are the maintenance shop and warehouse.

Leaching

In the leaching process, the sulphide concentrate mixed with water is treated in continuous autoclaves in a countercurrent system. Two stages, represented by an adjustment leach and a final leach, are carried out in agitator-equipped autoclaves at 170 to 180°F. and 100 to 110 p.s.i. pressure, measured amounts of ammonia and compressed air being charged to the system to react with the concentrate. Free from iron, the pregnant solution contains nickel, copper and cobalt amines as well as a number of ammonium salts, including thio-sulphate, thionate, sulphate and sulphamate. Dictated by the thio-sulphate and thionate sulphur requirements in the subsequent copper separation, about one-third of the total retention is at the solid feed or adjustment leach end and two-thirds at the liquid feed or final leach end.

The four-compartment adjustment leach unit consists of two 11-ft.-diam. by 45-ft.-long, 20% ELC stainless clad autoclaves which may be indepen-

dently operated, while the six final leach autoclaves, which are arranged in two independent lines of three in series, are of the same size and of a same construction material. The final leach autoclaves, however, have only 30-h.p. drives, compared with 50 h.p. in the adjustment leaches, and their cooling surfaces include only water jackets, shell and partitions, compared with water jackets, shell, partitions, heads, and coils in two compartments in the adjustment leach autoclaves. All the agitators are equipped with mechanical seals and a water-loaded internal seal. To adjust the retention time in the various stages as well as in the entire autoclave, which is a factor in thionate sulphur control, externally operated level control gates are provided. Reaction temperature is automatically controlled by cooling water flow, while automatic discharge from the autoclaves is effected through a level control mechanism on the final cells in each series.

Standard concrete shell and dome thickeners, with a one-course-brick lining over ¼-in. *Pyroflex* membrane and stainless-steel, closed-to-atmosphere disc filters, with nylon filter media, are used for interstage, liquid-solid separation in both the adjustment and final units. Closed-disc filters, operating at 50% pulp density, are used in the three-stage tailings wash circuit.

Boiling

The solution discharged from the leaching process is then boiled in a continuous unit to drive off free ammonia and to precipitate copper as sulphide by decomposition of the thionate present. The sulphide, containing about 70% copper, is treated to produce copper metals or salts, while the remaining solution is heated, oxidised and clarified in a continuous-pressure unit to convert the thiosulphate and sulphamate to sulphate and to produce a purified solution for nickel precipitation.

A five-plate distillation column, the copper boil unit at Fort Saskatchewan is intended for approximately 2-hr. retention time in continuous operation. The four first stages operate at temperatures of 200, 215, 220 and 225°F., respectively, and at pressures of 1.5, 2, 3 and 4 p.s.i., respectively, while the final stage or reboil is carried out at 230°F. and 6 p.s.i. pressure. To keep the copper sulphide precipitate in suspension, agitation is provided in stages 3 and 4 and in the reboiler. The precipitate is filtered and washed in 36 in. × 36 in., 50 p.s.i. maximum, leaf-type pressure filters and is, at present, sent to a smelter for treatment.

The filtrate from this operation is then treated in two parallel, five-compartment autoclaves at 225 to 250°F. and 3 to 15 p.s.i. pressure with concurrent additions of gaseous H_2S. This causes the precipitation of a mixed sulphide carrying copper and nickel, the copper in which is separated in presses, the remaining filtrate being taken to the metals recovery plant for oxydrolysis and nickel reduction. All the vessels used in the copper separation plant are of stainless steel.

Oxydrolysis

A fully automatic and continuous operation, oxydrolysis is designed initially to reduce the thionate plus thiosulphate content and then to reduce the sulphamate content, so producing a purified solution for nickel precipitation. It comprises two-step autoclaving in a temperature range of 350 to 475°F. and at a total pressure of 700 p.s.i. The copper-free leach liquor is fed, by means of 10-stage, vertical, 110-Imp.gal./min. centrifugal pumps discharging at a maximum pressure of 1,000 p.s.i. through a four-stage agitator-equipped autoclave at a temperature of 350°F. with an oxygen partial pressure of 100 p.s.i. and a total pressure of 700 p.s.i., both maintained by compressed air. This reduces the thionate plus thiosulphate content of the liquor to less than 0.005 g./l. before subjecting it to a higher temperature of 475°F. in a twin-autoclave train, where the sulphamate content is reduced to less than 0.05 g./l. The maintenance of these chemical limits is important both for nickel metal and ammonium sulphate purity.

Precipitation of nickel

Stored under pressure after clarification, this clarified copper-free solution is charged with hydrogen to an agitated autoclave, where the hydrogen reacts rapidly with the nickel amine to precipitate metallic nickel. It is a batch operation. First the autoclave is charged with the solution from which nickel nuclei may be produced with the gaseous hydrogen. After the nuclei have settled, the mother liquor is decanted and the autoclave recharged with reduction feed liquor, reducing with gaseous hydrogen. The decanting and reduction operation is repeated until the uniform nickel particles, in the form of a white powder, have increased to the desired size. These operations are carried out within a temperature range of 350 to 400°F., and with total pressures of 250 to 500 p.s.i.

On completion of the operation, the autoclave is emptied to 10-ft.-diam., cone-bottom flash tanks. In these the mother liquor overflows to a storage tank, while the metal settles into the bottom of the cone and flows out by gravity as a heavy slurry through a 'star' valve on to an Aitkens classifier and thence to a horizontal vacuum rotary filter, to both of which wash water is added. From the filter the powder is discharged into a 36-in.-diam. × 20-ft.-long direct-fired rotary drier, and thence to a storage bin, which discharges either to the powder canning section or to the briquetting factory.

To remove the 2% of nickel which forms a wall plating on the interior of the reduction autoclave and at the same time prepare the nucleation charge, barren liquor is charged into the autoclave after discharging the powder slurry. The plating is leached out at a temperature of 200°F., a total pressure of 200 p.s.i. and an oxygen partial pressure of 30 p.s.i., maintained with compressed air. Nickel powder is then added to this nickel-bearing solution to bring it up to strength for nucleation, this being followed by a further short leach.

Production of nickel powder averages 20 to 25 tons/cycle/autoclave for a normal cycle of 70 to 80 hr.

Cobalt precipitation and recovery of by-products

Nickel reduction does not reduce the cobalt present in the clarified copper-free solution, and so this end solution, which also contains about 2% of the nickel, is stripped with H_2S and the nickel-cobalt sulphide precipitate treated to separate the nickel and cobalt. The nickel is returned to the nickel precipitation unit and the cobalt is finally precipitated under pressure with hydrogen to produce metal having a +99.6 cobalt content. At Fort Saskatchewan there is a separate building for this process in order to provide for the safe handling of the H_2S which, in its gaseous form, is produced here by reacting molten elemental sulphur with hydrogen gas at a temperature of 850°F. and a pressure of 75 p.s.i.

The reduced mother liquor from nickel reduction is pumped to this building, where it is reacted with H_2S in a three-compartment, 6-ft.-diam. × 18-ft.-long, agitator-equipped autoclave at a temperature of 155°F. and a pressure of 5 p.s.i.

(*Concluded on page* 164)

★ Personal Paragraphs ★

★ **Mr. R. Turner,** chief engineer of Powell Duffryn Technical Services Ltd., has been appointed to the board of that company in place of Mr. G. W. Alexander, chief engineer of Powell Duffryn Ltd.

★ **Mr. H. D. Cummins** and **Mr. D. O. Hallett** have been appointed sales director and technical director, respectively, of a new company, Stainless Steel Plant Ltd. Mr. Cummins and Mr. Hallett formerly represented T. Giusti & Son Ltd., London.

★ Head Wrightson & Co. Ltd. have announced the appointment of **Mr. R. H. Sturges** (managing) and **Mr. R. Purnell** to the board of Head Wrightson Teesdale Ltd. (formerly the engineering division of Head Wrightson & Co. Ltd.).

★ **Mr. W. R. Edwards** has retired from the position of managing director of John Thompson Water Tube Boilers Ltd. after over 50 years of service with the John Thompson Group. For the time being Mr. Edwards is continuing with the John Thompson Group of companies in a consultative capacity. **Mr. C. J. Howard** has been appointed as managing director of John Thompson Water Tube Boilers Ltd. Mr. Howard has been with the company for 31 years, the last 20 years of which he has operated as London manager and director.

★ **Mr. W. H. Rogers** has been appointed industrial sales manager of British Oxygen Gases Ltd. He joined British Oxygen in 1935.

★ After 33 years with Chloride Batteries Ltd., **Mr. S. H. Chase** has retired. **Mr. D. S. Howarth** has taken over the position of manager, stationary battery sales.

★ The board of the Triplex Safety Glass Co. Ltd. announces that, on medical advice, **Field-Marshal Viscount Alanbrooke,** K.G., has been compelled to tender his resignation as deputy chairman and director.

★ The board of Imperial Chemical Industries Ltd. recently announced a number of appointments. **Dr. M. Cook** has been appointed chairman of the Metals Division and his place as joint managing director is taken by **Mr. St. J. Elstub. Mr. W. H. G. Lake** and **Mr. W. M. Ismay** are both appointed directors. **Dr. J. M. Holm** becomes the joint managing director of the Nobel Division and **Dr. A. D. Lees** becomes a director. **Dr. W. A. Caldwell** becomes development director of the division. **Dr. J. S. Gourlay** has been appointed chairman of the Paints Division. **Mr. J. C. H. McEntee** has been made chairman of the Wilton Council and his place as managing director has been taken by **Mr. R. E. Newell.**

★ Compania Shell de Venezuela Ltd. announces that **Mr. I. Davidson** will be resigning the presidency of that company as of June 30, 1957, although he will remain a member of the board of directors. It is the intention that Mr. Davidson will be appointed president of Canadian Shell Ltd., which has its seat in Toronto, Canada, as from July 1, 1957. It is also intended that he be appointed to the boards of the Shell Petroleum Co. Ltd. and N.V. De Bataafsche Petroleum Maatschappij. It is intended that Mr. Davidson be succeeded as president of Compania Shell de Venezuela Ltd. by **Mr. G. C. K. Dunsterville,** who has been a member of the Shell management in Venezuela since 1948 and a vice-president of Compania Shell de Venezuela Ltd. since its inception in July 1953.

★ **Mr. J. R. Gordon** has been elected executive vice-president of the International Nickel Co. of Canada Ltd. and also of the International Nickel Co. Inc., the company's U.S. subsidiary. He joined Inco in 1936 as director of the research department established that year at Copper Cliff, Ontario. **Mr. R. D. Parker,** a vice-president of the company, has been elected a director of the International Nickel Co. of Canada Ltd.

To Authors of Technical Articles and Books

The Editor welcomes practical articles and notes on chemical engineering and related subjects with a view to publication. A preliminary synopsis outlining the subject should be sent to The Editor, CHEMICAL & PROCESS ENGINEERING, Stratford House, 9 Eden Street, London, N.W.1.

In addition, the Publishers and Editors of the Leonard Hill Technical Group are always ready to consider technical and scientific manuscripts with a view to publication. Correspondence should be addressed in the first instance to the Book Production Manager, at the above address.

★ **Mr. H. W. P. Matthey,** chairman of Johnson, Matthey & Co. Ltd., died on March 6, aged 80. He joined the company in 1894 and became a director four years later. He became chairman of the company in 1928 and presided over its destiny throughout the difficult periods of the depression, of the 1939-45 war and of the reconstruction that followed.

★ **Sir Edwin Plowden,** chairman of the United Kingdom Atomic Energy Authority, left on March 15 for a visit to the Union of South Africa as guest of the South African Government. He will meet those concerned in South Africa with atomic energy development, and in particular with the mining of uranium.

★ **Mr. J. H. Whitney,** the new Ambassador from the United States, has resigned as chairman of the board of Freeport Sulphur Co. and **Mr. L. M. Williams,** president of Freeport, has been elected chairman to succeed him. Mr. Whitney resigned as chairman and as director on February 13, immediately after Senate confirmation of his nomination as Ambassador to the Court of St. James's in London. He had been elected a director of Freeport in 1930 and had become chairman in 1934. He resigned as chairman when he entered the U.S. Army Air Forces in World War 2, but returned to the post after the war. Mr. Williams, who has been active in the management of Freeport since 1930, will continue to serve also as president, a position he has filled since 1933. A former chairman of the National Industrial Conference Board, he is a director of B. F. Goodrich Co.

★ **Mr. G. D. Jones** has been appointed head of the material-control department of Quickfit & Quartz Ltd. He succeeds **Mr. C. B. Hudson,** who has been transferred to the safety-glass works of the parent company, the Triplex Safety Glass Co. Ltd., where he will act as assistant to the deputy works manager.

★ **Dr. L. Marion,** director, division of pure chemistry, National Research Council of Canada, has been named an honorary member of the Société Chimique de France. Dr. Marion is the first Canadian to be so honoured. The Chemical Society of France, which is celebrating its hundredth anniversary this year, now has 15 honorary members.

Chemistry, Defence and Industry

CHEMICAL INSPECTORATE'S 100 YEARS OF PROGRESS

Britain's Chemical Inspectorate is today a vast and busy organisation whose surprising range of activities affects a wide field of science and industry. Its story is revealed in a new book, 'Chemical Service in Defence of the Realm,' published by the Ministry of Supply and written by Mr. W. G. Norris, a well-known editor of the Leonard Hill Technical Group. Many recent chemical developments of the Inspectorate are described. The book is reviewed in this article.

THROUGH the Ministry of Supply the Government is a large producer and even bigger purchaser of weapons, equipment and materials required by the Services. To help control the quality and serviceability of its vast range of stores, the Ministry employs seven specialist Inspectorates. Because many of the stores have their basis in chemical technology, the Inspectorate with one of the widest responsibilities is the Chemical Inspectorate.

Springing from a small War Office establishment formed in 1854, the Chemical Inspectorate is today a large organisation of research and development chemists whose work covers a wide range of products—plastics, rubbers, lubricants, paints, textiles, explosives, pyrotechnics, building materials, penicillin, packaging materials etc. In the new book, Mr. Norris precedes his summary of the Inspectorate's work with a fascinating revelation of its history, and it is interesting to read of the important contribution of such distinguished figures as Sir Frederick Augustus Abel, the first W.D. chemist (in more recent years, the title W.D. Chemist has been replaced by Director of Chemical Inspection) and to see how ideas have changed about the organisation of research and development. We learn, for instance, that in instructions to staff on working procedure in 1919, the chemist is enjoined to 'adhere strictly to the methods laid down, which in most cases are of proved accuracy or specially adapted to the purpose.' Then follows: 'The chemist in charge of the section will, however, always be pleased to receive suggestions as to improvement or shortenings of methods, and such suggestions will in every case be carefully considered. It must be clearly understood, however, that no modification must be adopted until experimental proof of its accuracy has been obtained.'

Impeccable as these sentiments are, in view of the heavy responsibilities of the department, they are hardly calculated to inspire that critical approach and enthusiasm for improving existing methods and techniques which must be the lifeblood of any progressive analytical service. This cautious and somewhat complacent attitude has long been outmoded and today, of course, every chemist in the department is positively encouraged to spend as much time as possible on improving standard methods and developing new ones.

Work in civil field

Although the primary concern of the Inspectorate is defence supplies, much of its work—notably on paints, plastics and analytical methods—has civil uses too. When the Ministry of Supply took over Britain's atomic energy programme in 1945, C.C.I. (as the Inspectorate is still probably best known to hundreds of firms, from the letters which are printed on the approval mark or seal of the department which is affixed to materials that have been passed by the Inspector) was called upon to provide the analytical services necessary for the control of nuclear materials and through them the development of nuclear energy.

Paints

The outdoor exposure site of the Inspectorate's paint section, close to the Royal Ordnance factory at Glascoed, on which some 4,000 12-in.sq. test panels can be exposed simultaneously, is the largest of its kind in the country. The prime objectives of the site are to check the outdoor durability of protective coatings of any kind, including proprietary products, and to obtain a correlation between accelerated ageing tests as laid down in the specifications and actual outdoor exposure. Laboratory exposure tests and simple physical tests are also carried out. Paints are tested too at the M.o.S. Tropical Testing Establishment in Nigeria and at an exposure site in Australia.

The Services' requirements for paints are highly exacting and extremely varied, calling in some cases for products completely outside the normal range of industrial and domestic finishes. In addition, as in its other fields of work, the Inspectorate provides an advisory service on paints and other surface coatings to many other Government departments and M.o.S. establishments. Arising out of this, 30-odd research and development projects are currently being carried out. The problems involved range from such fundamental studies as the chemistry of etch primers to more practical questions such as the development of heat-resisting paints for the exhaust systems of vehicles, and the cause of and remedy for the blistering and loss of adhesion of alkyd paints under moist conditions.

Resistance to corrosion is, of course, a basic requirement of many paint systems. A current project, therefore, is concerned with anti-corrosive priming paints based on the new high-dispersion red lead, metallic lead (including micronised antimonial lead), lead cyanamide, and calcium plumbate, formulated with linseed oil, oleoresinous and alkyd media. According to preliminary results, it is reported, calcium plumbate is one of the best pigments and linseed oil is the best medium.

Petroleum products

Among current research projects at the Inspectorate's outstation at Covent Garden, where most of the work on petroleum products is carried out, are a number connected with the development of Institute of Petroleum test

methods. They include the determination of asphaltenes in oil, the storage stability and reactive chlorine content of cutting oils, an investigation into the extent of oil separation in the storage of grease, tetraethyl lead determinations, the determination of saponification value of oils, and the infra-red and spectrographic determination of additive elements in lubricating oils.

In the field of dry lubricants, work is in progress on molybdenum disulphide, a material which lubricates by adsorption on to metal surfaces and which, therefore, has high load-carrying characteristics. Methods for the complete analysis of molybdenum disulphide have been worked out and a specification for the material has been drafted. Further work is being done on sulphur determination in molybdenum disulphide by the quartz tube method.

Plastics

To cope with the growing scale of plastics inspection, a specialist section of the Inspectorate was formed early in the war. Today, this section, in the laboratories at Woolwich, is concerned with a greater variety of plastics than any other single organisation in the United Kingdom. The laboratories are equipped with all the apparatus and instruments required for the chemical, physico-chemical and physical testing of plastics.

One research project now in hand is an assessment of the weathering properties of polyester/glass fibre laminates; the reaction of various glycols with phthalic and fumaric (or maleic) acids is being studied by a variety of methods, including the cathode ray polarograph. This work, which is of fundamental interest from the point of view of both polyester resins and analytical techniques, will eventually lead to the framing of a specification for polyesters. The Inspectorate, together with other Government representatives, is working with the Plastics Federation on this subject.

Another investigation is being made into the causes of corrosion of ammunition components packed in resilient hair in polyester-glass fibre laminate containers. The major cause of the corrosion has been found to be acetic acid which has arisen from three different sources: firstly, hydrolysis of acetylated polyester resin; secondly, hydrolysis of the polyvinyl acetate binder present in the resilient hair; and, thirdly, hydrolysis of the same binder used in the glass mat. In the presence of monomeric styrene derived from the polyester, the second line of defence against corrosion, namely the enclosure of the component in double polythene bags, was ineffective. The transmission rate of water and acetic acid has been found to increase some 30-fold in the presence of styrene vapour. Suggestions have been made to prevent the corrosion.

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Wiley solvent extraction baths used in propellants inspection.

PVC is one of the vinyl plastics widely used in Service stores, polythene is an important packaging material and PTFE is used in fuses and for rocket components where its inertness and high resistance to temperature are invaluable. Nylon, too, has interested the Inspectorate for several years, certainly before it became available to industry as a moulding material. The Inspectorate was the first to discover and report on the phenomenon of embrittlement of nylon upon ageing. Viscosity measurements have shown that in test pieces there is a gradient of molecular weight from the surface to the core, the brown surface layer having the lowest molecular weight. A similar, but smaller, gradient has been found with a test piece which has not been heat-aged, indicating that the effect may arise in moulding. A paper chromatographic method for separating and identifying nylons has given independent demonstration of the gradient in molecular weight. Other investigations on nylon are afoot, in particular examination of test specimens and moulded items which have been exposed in the Tropical Testing Establishment.

Rubbers

Rubbers are examined at Woolwich in conjunction with plastics inspection. Inspection today covers the whole field of natural and synthetic rubbers, and physical as well as chemical testing is now carried out.

The Inspectorate co-operate with other departments in the development of many rubber components and stores. Recently a specification was developed for a proofed fabric suitable for making collapsible containers of up to 10,000-gal. capacity for aviation spirit. It comprises a nylon cloth coated inside with nitrile rubber for petrol resistance, and outside with neoprene for ageing resistance. The container can be packed flat in a box for easy transport.

Explosives

Few industrial concerns have the necessary knowledge and equipment to manufacture explosives and fill them into the many types of ammunition and weapons used by the Services and, as a result, this work is usually done in Government ordnance factories. Thus, technical problems can seldom be solved by drawing upon the experience of the chemical industry in general. The case of propellants is an example of the complexity of present-day inspection problems, compared with the examination of the old-fashioned cordite, for some propellants may contain five or six ingredients. One of the more important tests is the determination of total

volatile matter, for this influences the ballistics of a propellant.

While most problems can be solved by modification of established methods, the Inspectorate loses no opportunity of adopting new techniques when convinced that they are satisfactory and advantageous. This is shown by the history of the estimation of anti-flash potassium salts. At first they were estimated by the uranyl acetate method, but when polarography was taken up by the department its suitability for this particular problem was soon recognised. Still further savings are promised by the newly published sodium tetraphenyl boron method of potassium estimation. Infra-red spectroscopy, chromatography and flame photometry are other methods which have been adapted for propellant analysis.

Analysis

The booklet concludes with a chapter on the Inspectorate's analytical section, which proved so valuable when the Inspectorate was entrusted with the analytical work of the atomic energy programme in 1946. In April 1955, together with most of the other staff of the Inspectorate engaged on nuclear materials, this group was transferred, complete with equipment and buildings, to the U.K. Atomic Energy Authority. This left the Inspectorate with the task of forming a new research and development team. The basic organisation has now been established and given the title of Analytical Services and a promising programme of work has been organised embracing a variety of modern analytical techniques.

These are only some of the examples of the Inspectorate's work given in the book, which is authoritative, factual and readable and should interest and inform Government contractors and all manufacturers and users of the thousands of products based on chemical technology. Copies of the book (pp. 91, illustrated) are obtainable from the Ministry of Supply, Chemical Inspectorate, Station Approach Buildings, Kidbrooke, London, S.E.3.

Technology Notebook

Research — Education — Discussion

A.B.C.M. packaging committee

In view of recent important developments in the packaging field the Association of British Chemical Manufacturers has set up a packaging committee to watch the interests of the chemical industry. The committee will not provide a consultative service, but will ensure that where packaging policy in general is concerned, the Association is not at any disadvantage in relation to other industries.

The committee will co-operate with the British Standards Institution and with similar groups in other industries.

Education without examination

The French National Institute of Applied Sciences, which is to open in October in south-eastern France, will admit students without preliminary examination. The students will number 1,200.

Each student during the first year of the three years' course will be given training in conformity with his aptitudes and tastes. Those students having shown special aptitude will be trained for qualified positions as engineers. The others, according to their capacities, will follow courses of instruction fitting them to become skilled technicians. Diplomas will be granted.

Another innovation is that the Institute will not be exclusively for young students. It will provide courses for those already engaged in engineering who desire to perfect their knowledge and experience.

Close collaboration between the Institute and industry will be yet another feature. Some of the courses will have lecturers taken direct from industry and not from university circles. Research for private firms will also be undertaken.

B.I.S.R.A. 'open days'

Since the announcement last month of the forthcoming 'open days' at the B.I.S.R.A. Swansea laboratories, the original dates have been changed slightly. The event will, in fact, be held on June 19 and June 21.

Chemical research mission to Australia

Mr. G. Whitehead has temporarily left his job with the Atomic Energy Authority at Chester to carry out special chemical engineering research at the headquarters of Imperial Chemical Industries (Australia) Pty. Ltd. in the State of Victoria.

This is being done under a £1,000 fellowship awarded by the British Memorial Foundation. These special scholarships were started five years ago by businessmen and others in the State of Victoria and are maintained by public subscriptions. Four are now awarded each year.

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Tackling atomic reactor problems in Norway

A school for the advanced education of engineers working on atomic reactor problems is to be built at the Norwegian atomic research centre, Kjeller, and will be ready by Easter next year. The Netherlands government have contributed a large sum towards the school, and about half of the 30 students will come from their country. Formerly, a number of courses have been held, but it is now intended to have a permanent school of reactor technology.

New Ammonia Process

(*Concluded from page* 160)

After stripping and hydrogen precipitation, the solution remaining contains the sulphur dissolved during leaching. This is now present in the form of ammonium sulphate and the solutions are evaporated to produce a fertiliser-grade chemical, which represents an important by-product of the process.

The cost of developing this process has been estimated at about $2\frac{1}{2}$ million, but it is expected that this will be recovered in little more than a year of operating the new plant at Fort Saskatchewan.

World News

AUSTRALIA

Chemical and zinc plant

A new industrial plant to be built in New South Wales at a cost of A£8 million is intended to help Australia's primary industry needs, increase her dollar earnings and provide employment for more than 500 men. The plant, to be built by the Sulphide Corporation at Cockle Creek, will produce zinc, sulphuric acid and superphosphates. It is planned to begin operating in about three years' time.

The Cockle Creek project will also double Australia's superphosphate production to almost 430,000 tons p.a., while production of sulphuric acid will rise from 30,000 tons to 45,000 tons.

ISRAEL

New carbide factory

A new factory for the production of carbide is to be set up near Petah Tikva using locally discovered deposits of lime; I£1 million is to be invested, two-thirds by a group of local investors and the remainder from investors in Switzerland and the United Kingdom. The enterprise is scheduled to begin production before the end of 1957. Output is planned at 4,000 tons p.a., of which 1,000 tons are for export and the remainder to meet local demand.

BRAZIL

Swiss factory for chemical products

The Swiss firms of Sandoz, Geigy and Ciba are going to establish jointly a big factory for chemical products in the Resende district in Brazil. It is claimed that this plant will be the most important of its kind in South America. Building will be started some time this year, and production will begin in 1959. It is anticipated that the initial annual output will amount to 300 tons of aniline and to 150 tons of chemical products for the pharmaceutical industries and for tanneries.

New plastics and petrochemical plant

Union Carbide do Brasil S.A. (a U.S. subsidiary) have announced the establishment at Cubatao of the first polythene factory in South America, which will be ready by 1958.

The director of the privately-owned Uniao petroleum refinery at Capuava, State of Sao Paulo, has announced the conclusion of negotiations with the W.R. Grace Co. of America, covering the purchase of equipment worth U.S. $50 million for a petrochemical plant.

INDIA

More soda ash

A further expansion of Tata Chemical Ltd. for production of soda ash has been sanctioned by the Government. When the scheme is completed in some three years' time the plant will produce 400 tons/day of soda ash.

CANADA

Urea plant

Canada's first urea plant is to be built at Hamilton, Ontario, by North American Cyanamid Ltd., a subsidiary of the American Cyanamid Co., in association with Dominion Foundries & Steel Ltd. The $15-million plant will have an initial capacity of 66,000 tons p.a. of urea and 52,500 tons p.a. of anhydrous ammonia. Dominion Foundries will supply raw materials from by-products of its adjacent steel mills.

GREAT BRITAIN

New water-gas process for Shell Haven

A new process for conversion of oil under pressure into water gas will be used at the £6-million plant now under construction at Shell Haven, in Essex, for the manufacture of nitric acid and ammonia which is to form the basis for large-scale production of agricultural fertiliser. Until now, such gas has been produced in Europe mainly from coke and coal. Other uses of the process are in the steel industry and for the manufacture of town gas.

Evolved by n.v. de Bataafsche Petroleum Maatschappij, one of the main operating companies of the Royal Dutch/Shell Group, the new process can use any hydrocarbon ranging from gas to heavy fuel oil as base material and offers an economically attractive and flexible new technique. The first commercial unit in Europe is already operating successfully at Ijmuiden, near Haarlem, in the Netherlands.

Atomic power station for Northern Ireland

It has been announced in the Northern Ireland House of Commons that it has been decided to proceed with plans for an atomic power station in Northern Ireland to be brought into operation in 1963-64.

The output will be 150 mw., and

VACATION COURSES FOR STUDENTS

Since 1946, nearly 900 university students have attended vacation training courses at Shell oil refineries, chemical plants, research centres and laboratories in the United Kingdom. The picture shows a senior technologist with science students attending a technical training course at Stanlow chemical plant, Cheshire.

the station, estimated to cost £25 million, will be established and operated by the Electricity Board, who have already arranged for the special training of engineers.

New Grangemouth chemical plants commissioned

British Hydrocarbon Chemicals Ltd. announces that its two new plants for the production of ethylene and ethanol (industrial alcohol) have been successfully brought into commercial operation, and have doubled the existing capacity for these basic chemicals.

The decision to construct these two plants was announced in June 1955 as part of the £8 million expansion programme of the company's chemical works at Grangemouth, Scotland.

All-glass plant handles hydrochloric

A 25-ft.-high glass installation has been erected for work on one of the components for *Terylene* manufacture in the research works of the Billingham division of I.C.I. by Q.V.F. Ltd.

Work on the plant took only three months, during which time not a single piece of glass was broken. This is the first plant to be constructed entirely of glass in the Billingham division of I.C.I.

Hydrochloric acid is one of the principal chemicals used in this process, and the glass pipeline is entirely resistant to the highly corrosive acid. The glass is also heat resistant.

Housed in a small building of its own, the plant requires only one man as operator on each shift, being for the most part controlled by instruments.

"YES, HE KEEPS HIMSELF TO HIMSELF, BUT HE'S A GOOD MIXER"

SOUTH AFRICA

Lubricating oil and grease

The Shell Co. of South Africa, Ltd., have been spending about £1 million on a development scheme at Island View, Durban, providing new lubricating oil and grease plant. The original plan was only to erect a lubricating oil plant but later the decision was taken to add a grease plant. This will replace the small blending plant the company has operated in Durban for a long time. The new plant is designed to meet the needs of both the Union and the Federation for lubricating oil and greases, as it is intended to produce 150 types of lubricating oil and 50 grades of grease.

New tantalite deposits

Large new deposits of tantalite have recently been discovered in the vicinity of Karasburg in the southern part of South West Africa by two prospectors on routine diamond prospecting work. It is claimed that the new deposits seem to be the richest of their kind in South West Africa.

The two prospectors are in the employ of a large diamond corporation mainly concentrating on prospecting for diamonds in an area over which it has obtained a concession. It is stated that the diamond company concerned contemplates co-operating with a large American mining corporation in order to exploit the new discovery. Large-scale prospecting and mapping of the area has already been undertaken.

Carbon equipment

Associated Engineers Co. (Pty.) Ltd., Johannesburg, who established a carbon and graphite products factory in the Union about five years ago, recently extended their range to include carbon brushes for electrical machines, starter and generator brushes for automobiles, graphite electrodes, carbon contacts for drum controllers and switchgear, carbon clutch rings for automobiles, carbon moulds for for the diamond industry and carbon tubes and rods for the chemical industry.

NICARAGUA

Rubbish into fertiliser

The coffee planters' co-operative are about to construct a modern fertiliser plant in Managua which will use as its basic material the 100 tons of rubbish collected daily by the municipal authorities. It is anticipated that the plant will produce about 100 quintals/day of fertiliser. The funds for the construction of the plant have been granted by the Government to help the coffee industry.

BURMA

Japanese co-operation in fertiliser factory

It is reported that the Burmese Industrial Mission have reached an understanding with leading Japanese fertiliser firms on the establishment of a joint chemical fertiliser factory in Rangoon. The initial target of this joint venture is said to be the production of 50,000 tons of a chemical

The Leonard Hill Technical Group—April

Articles appearing in some of our associate journals this month include:

Atomics—Treatment of Highly Active Wastes; Chemical Processing of Nuclear Fuels; Ion Exchange and Atomic Energy; Chemical Aspects of Nuclear Power, 1; Engineering Problems of Nuclear Power, 1; Zirconium and Nuclear Power.

Petroleum — Geology of the Middle East; Rust Preventatives from Petroleum; Corrosion in Oil Refinery Effluent Plants; Preventing Corrosion Caused by Crude; The Value of Cathodic Protection.

Manufacturing Chemist—Fatty Acyl Alkylolamides, 2; Sugar Cane Wax; The Flexible Gelatin Capsule—Its Manufacture and Uses; A Century of British Fertilisers—History of Lawes Chemical Co.; Progress Reports.

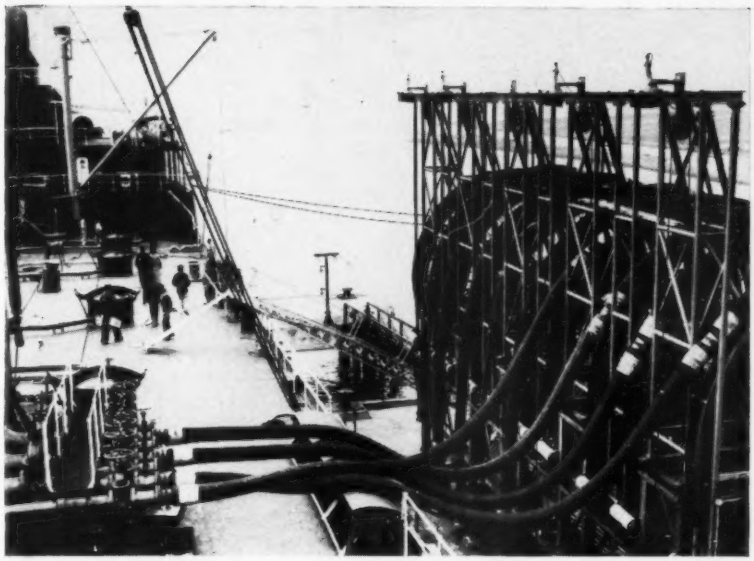
Food Manufacture—Review of Soft Drinks Industry; Soft Drink Makers' New Plant; Beverage Filtration Equipment and its Management; Concentrated Apple Juice; Manufacture of Frozen Baked Goods; Glyceryl Monostearate in Foods.

Automation Progress — Recent Developments in Digital Machine Tool Control; Automatic Shunting of Goods Wagons; Pneumatic Control and Power; Character Recognition Procedure; Control Plant for World's Largest Nuclear Power Station; Special Purpose Machines.

Dairy Engineering—An Underground Milk Reception Plant; Stainless Steel *v.* Wooden Butter Churns; Glass Bottles Serve the Dairy Industry; Orange Drink Production for the Dairyman; Personnel Management and Automation in the Dairy.

World Crops—Cotton Production in the U.S.A.; The Empire Cotton Growing Corporation; Rubber: the Plant with 50,000 Uses; The Art of Budgrafting.

Paint Manufacture—The Paint Industry in Perspective; Safety and Welfare in the Paint Industry; Fire Precaution; The Arrangement of Canteen Facilities; Planning a Pension Scheme; Inspecting Plant; Emphasising Safety with Photographs.



MAJOR ADVANCE IN HOSE-HANDLING EQUIPMENT

The hose-handling structure at a new tanker jetty at the Coryton Refinery, Essex, is the only one of its type in Europe. The hoses are retained on ten large reels, each 18 ft. in diameter and each accommodating 60 ft. of 8 in. diameter hose. When a tanker berths alongside, a snatch-block is carried to the deck of the ship and the tail of a wire carried back to the end of the hose which is then drawn to the ship's outlet valves by means of a winch on the jetty deck. The required length of hose is allowed to run out by the turning of the reel, which is hydraulically operated. Oil pumped from the tanker passes via the hose and a radial pipe through the hollow swivel hub of the reel into the pipeline feeding the storage tanks.

fertiliser, mostly phosphate and nitrogenous manure, rising eventually to an annual output of 100,000 tons.

UNITED STATES

Butyl rubber plant

A new plant for butyl rubber is to be built at Lake Charles (Louisiana) by Petroleum Chemicals Inc., with an initial capacity of 30,000 tons p.a., at an investment cost of $17 million.

Cellulose sheet factory

A new plant to manufacture transparent cellulose sheet with a projected capacity of 50 million lb. p.a. is being planned by the Dupont Co. near Topeka, Kansas.

Chemical cleaner for tankers

A new chemical detergent has been developed which will make it possible for a tanker that carried a cargo of crude oil to switch quickly to a cargo of edible oil or even grain for a return voyage.

This granular detergent, *Planisol*, has been introduced by the Dunham Chemical Co., a subsidiary of the National Cylinder Gas Co., and can be applied by a hose with a spinning nozzle, requiring no scrubbing.

The solution can be recirculated through one tank after another and it is claimed that the system cuts tank cleaning costs by as much as 60%. Formerly, ships were forced to carry water as ballast from Europe to the Middle East owing to the high cost of cleaning the crude oil from their tanks.

New refinery planned

El Paso Natural Gas Products Co. plans to build a 6,500-bbl./day refinery and alkylation plant near Odessa, Texas. The plant will be connected with El Paso, a distance of more than 250 ml., by a 6-in. pipeline.

The refinery will be built near the proposed plants of Odessa Butadiene Co. and Odessa Styrene Co., in which the products company holds a majority interest. About 2,000 bbl./day of by-products from the two plants will be converted by the alkylation unit into a blending component for high-octane motor and aviation petroleum.

Styrene and butadiene from the two petrochemical plants will be used by a General Tire & Rubber Co. synthetic rubber plant also being built nearby. The cost of the proposed plants was not disclosed.

NETHERLANDS

Hydro-sulphide production

The Royal Netherlands Salt Industry at Hengelo now has under construction three buildings for the manufacture of hydro-sulphide, used for dyeing cotton. The process being used is new and production is expected to start by the middle of this year.

JAPAN

Processes for terephthalic acid and DMT

Mitsui Petrochemical Industries Ltd. has announced the acquisition of a licence in Japan on unique liquid-

MEETINGS

Society of Chemical Industry

Chemical Engineering Group

April 8 and 9. Symposium on Safety, 14 Belgrave Square, London, S.W.1.

Institution of Mechanical Engineers

April 12. 'The Influence of Dynamical Imperfection on the Vibration of Rotating Discs,' by S. A. Tobias and R. N. Arnold, 6 p.m., 1 Birdcage Walk, Westminster, London, S.W.1.

Institute of Fuel

April 10. 'Koppers-Tolzek Gasification Process,' by Hans Koppers, 5.30 p.m., Institution of Civil Engineers, Great George Street, London, S.W.1.

Incorporated Plant Engineers

April 2. 'Applications of Plastics in Industry,' by C. L. Child, 7 p.m., Royal Society of Arts, John Adam Street, Adelphi, Strand, London, W.C.2.

April 11. 'Engineering in the Making of Refractories,' by E. Snodgrass, 7.15 p.m., Exchange Hotel, Liverpool.

INTERNATIONAL CONFERENCES

April 15-17. 'The Molecular Mechanism of Rate Processes in Solids (Involving Mass Transfer).' Joint discussion Faraday Society—Royal Netherlands Chemical Association, Amsterdam.

phase, air-oxidation processes for the production of terephthalic acid, dimethyl terephthalate and other aromatic intermediates from petroleum-based feedstocks. The new processes will be used at Iwakuni City in Japan, where the first phase of a $30 million petrochemical project is already well under way.

The processes to be used by Mitsui were discovered and developed by Scientific Design Co. Inc., New York, and associated companies. Standard Oil Co. (Indiana) has also done considerable research and development work on these processes and has recently acquired the entire rights to the processes.

IRAQ

Exploitation of natural gas

The Minister of Finance and Economy announced recently that the Iraq Government was considering the possibility of exploiting natural gas deposits in Iraq. It was pointed out that Iraq could be assured of 120,000 tons p.a. of sulphur, which would enable her to set up a chemical fertiliser plant.

WESTERN GERMANY

Potash industry

The 15 West German potash mines produced 1,700,000 tons of potash (in terms of K_2O) last year—almost the same quantity as in the previous year. Potash sales rose by nearly 10% last year. Domestic sales increased by 5.5% and exports by 15.5%.

Synthetic rubber

The Badische Anilin-und Soda Fabrik (B.A.S.F.) Ludwigshafen; Farbenfabriken Bayer, Leverkusen and Farbwerke Hoechst, Frankfurt-am-Main (the three successor companies to the pre-war I.G. Farbenindustrie) have jointly established a company known as Synthesekautschuk-Beteiligungs GmbH., with a capital of DM 60,000, to look after the interests of the three companies in the synthetic rubber manufacturing company Bunawerk Hüls, GmbH.

New intermediate for plastics

Knapsack-Griesheim, A.G., chemical manufacturers, are stated to have developed a new intermediate product for the production of plastics. The new product will come into production under the name *Chloropren*. The *Chloropren*, it is reported, will be polymerised at Bayer's plant in Leverkusen.

It is also reported that the Knapsack works have raised their annual capacity for yellow phosphorus to 35,000 tons. This will enable the company to meet all German requirements and, later on, will produce an export surplus for sale to neighbouring countries.

COMPANY NEWS

Kek Ltd. have recently announced the completion of an agreement with the Fluid Energy Processing & Equipment Co., of Philadelphia, U.S.A., giving them the sole agency for the sale of Wheeler-Stephanoff fluid energy jet mills in Great Britain. It is later planned to extend this agreement to cover the whole of the sterling area, and Kek Ltd. will also commence manufacture of these grinders in the near future.

The Wheeler fine-particle mill has no moving parts. Material at approximately 4 mesh or less is fed in at a controlled rate and entrained by energised fluid (air, steam or any gas or vapour) travelling around the reduction chamber at sonic or supersonic velocities. Particles break themselves up by repeated shattering against each other. When they reach desired size (micron or sub-micron) they escape with spent fluid through the classifier outlet into collectors of Wheeler design. Centrifugal force keeps the coarser particles toward the outside of the circuit until they grind each other down.

*

Shell Chemical Co. Ltd. announce that a further step forward in their development of Ziegler polythene will take place with the coming into production, in the early summer, of a plant at Partington having a capacity of 1,000 tons p.a. They also announce that they have appointed Messrs. Erinoid Ltd., of Stroud, as an agent to handle part of their sales of Ziegler polythene in the United Kingdom, particularly in the injection moulding field.

*

It has also been announced by Shell Chemical Co. Ltd. that all head office departments, with one exception, will be located in the company's new building at Marlborough House, 15-17 Great Marlborough Street, London, W.1 (Telephone No. Gerrard 0666). Plastics and resins department will remain at the company's former address, Norman House, 105-9 Strand, W.C.2.

*

British Industrial Solvents has announced that, owing to the substantial rise in the cost of ethyl alcohol, it has been necessary to increase the prices of *Bisol* products based on this material. The products affected include acetic acid, acetic anhydride, acetates, acetoacetarylamides and miscellaneous other chemicals. A list showing the main price changes is available from the company. Partly offsetting these increases, larger allowances will be made to customers taking tanker deliveries of acetic acid, acetic anhydride and acetates.

*

Due to continued expansion, the Middlesbrough branch office of Honeywell-Brown Ltd. has moved to larger premises. All enquiries concerning industrial instrumentation, heating and air-conditioning controls, and precision switches, should be addressed to: Honeywell-Brown Ltd., 52-60 Fletcher Street, Middlesbrough.

*

Contracts for over 200 miles of tubing, mainly of austenitic stainless steel, have been received by the Tube Investments subsidiary, Accles & Pollock Ltd., Oldbury, Birmingham, from the A.E.I.-John Thompson Nuclear Energy Co. Ltd. and the G.E.C.-Simon-Carves Atomic Energy Group, who are building the nuclear power stations in Gloucestershire and on the Ayrshire coast. Each reactor will be equipped with 'burst slug' detection gear, which enables faulty fuel elements to be detected immediately, and removed, so preventing contamination of the reactor and heat exchangers. This detection is effected by taking regular samples of gas from inside the reactors, and the tubes ordered are used for conveying these gas samples to the monitoring instruments. Some of the tubes will be supplied in straight lengths and others manipulated and part fabricated.

*

Imperial Chemical Industries Ltd., the largest producer of titanium in Great Britain, has announced substantial reductions in the price of its wrought titanium and titanium alloy products. While continuing to vary according to the form of wrought product and the grade or alloy of titanium used, prices will in general be lowered by 10%.

INDUSTRY REPORTS . . .

Rubber industry manufacturing developments

Tyres having ceased to be a major factor in the total business of the British Tyre & Rubber Co. Ltd., the board has decided to apply the efforts and capital resources of the company to the newer developments of thermoplastic and rubber products in the industrial field. Some of these products are rubber and plastic linings for the chemical and allied industries and vibro-insulators to meet complex anti-vibrational problems, roller coverings for the paper-making, printing, steel and textile industries, and cutless rubber bearings. Explaining these manufacturing developments in his annual statement, the company's chairman, Sir Graham Hayman, also announced that good progress is being made on the company's new factory at Farington. It is expected to be in operation early in 1958 and will provide expanded manufacturing facilities for specialised industrial rubber products.

Q.V.F. German subsidiary thrives

Despite very keen competition from German manufacturers and the difficulties entailed in starting a new company from scratch in a foreign country, it is fully anticipated that the new German subsidiary of the Triplex group of companies, Q.V.F. Glastechnik GmbH, will break even and may perhaps show a small profit in the current financial year.

This is stated in the interim report of the directors of the Triplex group for the half year ended December 31, 1956. Q.V.F. Glastechnik was established early last year to manufacture glass pipeline and plant to supplement the range imported from England by Q.V.F. Ltd. Headquarters and works of the German-based firm are at Wiesbaden.

Motors for chemical plants

In a review of developments in 1956, the British Thomson-Houston Co. Ltd. reports that the ever-increasing demand from power supply authorities and industrial undertakings at home and overseas for electrical equipment of every kind has kept B.T.H. factories operating at full capacity. Among the equipment installed has been that for the Mond Nickel d.c./a.c. changeover at Clydach, involving to date over 800 motors ranging from 1 to 170 h.p. Over 600 have been delivered to the site where the new power plant has been completed, and installation of the motor changeover is proceeding. It was expected that all the equipment would be commissioned early in 1957.

The new Associated Ethyl chlorine plant at Ellesmere Port, when completed in 1957, will be powered by 220 B.T.H. motors from 2 to 125 h.p. Deliveries are proceeding and, when complete, over 2,100 B.T.H. motors will be in service at this plant.

At the extension to Fison's Plymouth works, 68 B.T.H. motors will provide power for the granulating, bagging, conveying, and intake machinery.

Citric acid production increased

At a recent company meeting, Mr. A. L. Wilson, chairman of John & E. Sturge Ltd., of Birmingham, said that during 1956 the total exports of citric acid were 50% greater than during the previous year and that shipments had been made to over 40 countries. In addition to the output of the company's French and Canadian factories, over half the total production of citric acid and other chemicals from the U.K. factories was directly exported. The first stage of the £250,000 expansion scheme, started last year and designed to increase output of citric acid by 70%, has been completed.

Electrical equipment for industry

Among the items of equipment supplied by Metropolitan-Vickers Electrical Co. Ltd. to various branches of the industry during 1956, and reviewed in the company's 'Gazette,' are turbine-generator sets; rectifiers; transformers and switchgear for works power and distribution systems; together with a variety of equipment for electric drives, welding, heating, testing, and other applications.

General Tyre & Rubber Co. expansion

Sizable gains in all its basic operations, rubber, plastics, chemicals, rockets and entertainment, are expected in 1957 by the U.S. General Tyre & Rubber Co, according to Mr. W. O'Neill, president of the company. In anticipation of this increased demand, the company completed or began major expansions during 1956 as part of a $40 million two-year capital expenditure.

Mr. O'Neil said that General Tyre is accelerating its research and development programme and is now adding a $1 million unit to its Akron, Ohio, research facilities. The firm's integrated synthetic rubber plant at Odessa, Texas, he reported, is scheduled to go into operation in the third quarter of 1957.

Increased chemical sales

Consolidated net sales of the American Cyanamid Co. for 1956 were approximately $500,651,000 as compared with $451,088,000 for 1955. While *Formica* products accounted for the major portion of the higher sales volume, important increases occurred in a number of products, including titanium dioxides, malathion, and phosphate rock.

De-tinning can scrap

A workable process for the removal of the ½% tin content from discarded tin can scrap is claimed to have been developed by the Research Division of the College of Engineering of New York University. However, experiments are still going on and the full details and potentiality of the process have not yet been revealed.

A division report disclosed that the process was tested in 3-ton batches in an open-hearth furnace before being turned over to the sponsor—the Scrap Conservation Committee of the Steel Industry—for further development.

The report said that if the process were applied to the approximately 3 million tons of tin cans discarded annually in the U.S. the resulting detinned steel scrap would add materially to the U.S. supply. Tin can scrap cannot now be used in open-hearth furnaces, mainly because of the effect that the tin content has on furnace linings.

There are several companies producing de-tinned scrap, but not on a very large scale.

Several factors have still to be worked out before the full practicability of the pilot work could be substantiated.

British Patent Claims

Ion-exchange resins

An insoluble ion-exchange resin, preferably phenolic, with an arsonic-acid radical available for ion-exchanging and its production by preparing a low mol.wt. aromatic hydrocarbon derivative with an arsonic-acid radical and OH or NH_2 groups and condensing with NCHO.—762,085, *National Research Development Corp.*

Corrosion inhibitors

A composition suitable for maintaining in contact with water to prevent metal corrosion comprises a hydrocarbon containing a dissolved $< C_{20}$ salt of a $< C_6$ polybasic carboxylic acid and an alkylene polyamine having at least one H atom on each N atom. The composition is particularly used with organic materials, *e.g.* gasoline, etc., containing small quantities of water.—762,228, *Universal Oil Products Co.* (*U.S.*).

Production of titanium or zirconium

Ti or Zr tetrachloride vapour is continuously reacted with Na or K vapour in a reaction vessel lined with Ti or Zr; the NaCl or KCl is removed as vapour and the Ti or Zr drips down to form pellets in a bath of molten salt. The apparatus is claimed.—762,519, *National Smelting Co. Ltd.*

Centrifugal separator

The centrifuge drum has upper and lower parts secured together by a screwed ring, and a sealing ring, which co-acts with a ring valve for sludge discharge, is located loosely in a recess in the upper part, with its upper and inner faces in contact with such part, and its outer face in contact with the lower part.—763,429, *Westfalia Separator A.G.* (*Germany*).

Heat-transfer system

A fluidised bed of heat-transmitting solids engages a heat-transmitting wall (*e.g.* of a chemical reactor), and such bed is contacted with a liquid (*e.g.* water) which is vaporised and passed upwardly to maintain fluidisation and to cool the solids.—763,469, *N. V. de Bataafsche Petroleum Mij.* (*Netherlands*).

Cellulose chlorination

The non-cellulosic components of semi-chemical cellulose are made soluble by $<$ three successive reactions, at increasing cellulose dilution, with molecular chlorine, without intermediate alkaline treatment. The apparatus used is claimed.—764,425, *S.p.A. Sindicato Cellulosa Pomilio et al.* (*Italy*).

Control valve for chemical plant

A plug valve, *e.g.* for a fluid catalytic cracking system, incorporates a spring mechanism which automatically accommodates dimensional changes due to heat expansion and contraction.—766,506, *M. W. Kellogg Co.* (*U.S.*).

Corrosion-resistant glass, etc., materials

A web or fabric of glass or mineral fibres is impregnated with a dispersion of polytetrafluoroethylene in a volatilisable liquid medium, the liquid is evaporated from the impregnated material by heating and the material is then subjected to pressure at an elevated temperature below the sintering temperature of the polymer; the above three-stage treatment is repeated at least once and finally the material is heated to the sintering temperature of the polytetrafluoroethylene.—766,841 *United Kingdom Atomic Energy Authority.*

Polymerisation of styrene

Polymers and copolymers of high heat distortion temperature are produced by heating styrene (alone or with a minor proportion of an ethylenic monomer) at 90 to 160°C. and $<$10,000 p.s.i. until 90%wt. of the monomer(s) has polymerised, then at $>$170°C. until the monomer content is $<$1.5%wt.—764,465, *Monsanto Chemical Co.* (*U.S.*).

Distillation, etc., apparatus

A method for stagewise contacting gas and liquid, in each stage of which the upwardly flowing gas is given a rotary motion by stationary vanes extending from a central hub to an outer cylindrical member, the vanes being inclined to, and in no part parallel to, the axis of the apparatus; the liquid flows by gravity and is introduced at or near the centre of the gas zone and dispersed into drops by centrifugal force of the gas.—764,859, *W. S. Norman.*

Extractive distillation of ethyl acetate

Ethyl acetate is separated from liquid mixtures containing difficultly separable components by distillation in a column into the upper part of which an auxiliary liquid is introduced which simultaneously extracts ethyl acetate and distills azeotropically with at least one other component, so that the ethyl acetate is washed down the column and the other component distills overhead as an azeotrope; extract and distillate are worked up in known manner.—765,334, *Dr. A. Wacker Ges für Elektrochemische Ind.* (*Germany*).

Carbon black

The flow properties of carbon black are improved by contacting, *e.g.* rubber grade, carbon black with an alkaline earth metal mahogany sulphonate (Ca, Ba or Sr salt), as such or in solution, *e.g.* in a mineral oil. Ink containing the treated product is claimed.—764,929, *J. M. Huber Corp.* (*U.S.*).

Beryllium

Entrained chloride is removed from electrolytically produced Be by comminuting to reduce particle size and expose chloride and leaching with an aqueous solution of an organic compound capable of forming a chelate complex with Be.—765,692, *United Kingdom Atomic Energy Authority.*

Valve for viscous liquids

The liquid passes through a gap between a valve seat and a rotatable plug valve, the latter being oscillated to assist flow. Tar, grease, paint, wax etc. are mentioned.—766,008, *North Thames Gas Board.*

Plutonium separation

Plutonium phosphate is separated from a mixture with Zr, Bi and Nb phosphates by treating with diluted HCl to dissolve Bi phosphate and treating the insoluble residue with 7N.HCl to dissolve Pu phosphate.—765,924, *F. Morgan.*

Heat exchanger construction

Plate units (*e.g.* for a transformer-cooling heat exchanger) for assembly into a set by welding; each consist of a rectangular plate with oppositely-cranked edge portions, which is transversely bent relative to such portions at 90° about parallel lines to provide multi-spaced parallel walls. The cranked portions are edge-welded where they engage.—766,331, *W. J. Fraser & Co. Ltd.*

The above abstracts are reproduced from the weekly Patents Abstracts Journal *by permission of the Technical Information Co. The complete specifications can be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, price 3s. 6d. each.*

TOPICS OF THE MONTH

Royal Charter for Institution of Chemical Engineers

THE grant of a Royal Charter to the Institution of Chemical Engineers reflects the importance attached to chemical engineering today and cannot but add to the high esteem in which the profession is already held. This latest development must be regarded as the crowning achievement of the body of industrialists, chemists and engineers who came together to found the Institution in 1922, and of those who have carried on the good work since.

The Institution came into being because it was found that the design and operation of chemical plant needed its own engineering discipline, but there was no splitting off from other professional institutions, who were all consulted about the new foundation. Agreement was general that a new qualifying professional body alone could organise the study of the new technology. The qualifying activities of the Institution are still of first importance, though the task of examining students is lightened by the growth of degree, diploma and postgraduate courses in chemical engineering in the universities and colleges of technology and by the courses for the higher national certificate.

The membership of the Institution has grown steadily, so that today the number has risen to 3,500 from 880 in 1936. The extension of the Institution's influence to the Commonwealth is also to be noted and there is a strong branch in South Africa and advisory panels operating in Australia, India and New Zealand. The status of the Institution in Europe was acknowledged when, through the Department of Scientific and Industrial Research, an invitation was issued to organise a conference on the ' Functions and Education of the Chemical Engineer ' under the auspices of the O.E.E.C.

A number of other conferences and symposia organised by the Institution have attracted considerable attention, the latest being the symposium recently held at Birmingham University, of which an account is given in this issue. Such activities as these, along with the impetus the Institution gives to educational progress, are much to the ultimate benefit not only of the Institution's members, but also of industry and the country at large.

Chemical processing of irradiated fuel

A NUMBER of O.E.E.C. working parties have been considering various aspects of European co-operation on atomic energy under the Steering Committee for Nuclear Energy set up by the decision of the Council of Ministers on July 18, 1956. Among the more important subjects under consideration is that of a joint chemical separation plant, and a study group has recommended that, as a first step, a small plant with a capacity of 50 tons p.a. should be built by 1960 for processing uranium up to medium enrichment. It would both provide processing capacity adequate for Continental Europe's immediate needs and serve as a pilot project for larger plants later on.

The United Kingdom is willing to provide advice and help (where appropriate on commercial terms), but will not participate in the pilot plant because its own capacity will be more than adequate for its immediate needs.

The U.K. has not committed itself as regards participation in a major plant.

Chemicals and manpower in the U.S.

IN discussing the shortage of chemical engineers in Britain and other parts of Europe, comparisons are often made with Russia and the United States and it is not always realised that in the latter country, at least, there is a shortage which is regarded just as seriously. The American chemical industry has been pressed to review its policies regarding personnel to avoid manpower shortage between now and 1967 and a U.S. Labour Department official told a meeting of the American Institute of Chemical Engineers recently that the continued emphasis on research and development, and the greater complexity of chemical products and processes, are expected to give rise to ' disproportionately ' rapid increases in demands for chemists, chemical engineers and technicians within eight years.

This will mean the industry taking account of the change in American manpower trends in the coming years. Of an expected increase of 10 million in the number of workers, about 5 million will be men, half of whom will be under 24 years of age. The American chemical industry will have to place greater emphasis on testing, placement and on-the-job training if it expects to tap this willing but inexperienced manpower pool.

Controlling boredom in the control room

EVEN in the petroleum and chemical industries, which have long been ahead of other industries in the application of automatic controls, more and more processes and operations are becoming automatic but still require some form of supervision, so that there will be an increasing number of industrial workers who find themselves in the position of sentries, or pilots on long-distance flights. Where there is nothing to do but to hang about watching dials or waiting for audible signals the danger of boredom presents itself and a recent editorial in *Automation Progress* (one of